GEOMATRIX

FINAL TECHNICAL REPORT
PALEOSEISMIC INVESTIGATION OF THE SAN ANDREAS FAULT ZONE IN PORTOLA VALLEY, CALIFORNIA

San Mateo County, California

Prepared for:

United States Geological Survey
905A National Center
12201 Sunrise Valley Drive
Reston, VA 20192

March 2002

Project No. 6426

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GEOMATRIX

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External Research – Final Report
U.S. Geological Survey
905A National Center
12201 Sunrise Valley Drive
Reston, VA 20192

Subject: Final Technical Report
Paleoseismic Investigation of the San Andreas Fault Zone
in Portola Valley, San Mateo County, California

Ladies and Gentlemen:

Attached is the Final Technical Report for Award No. 01HQGR0009. We are including one (1) unbound original and four (4) bound copies. Also included is a compact disk containing the report (text, tables and figures/plates) in Adobe Acrobat PDF format.

We have enjoyed working on this challenging research program and hope that we have made a significant contribution to characterizing earthquake hazards in the San Francisco Bay area.

Sincerely,
Geomatrix Consultants, Inc.

Robert H Wright

Dr. Robert H. Wright
Senior Consulting Engineering Geologist

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FINAL TECHNICAL REPORT

Paleoseismic Investigation of the San Andreas Fault Zone in Portola Valley, California

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National Earthquake Hazards Reduction Program

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March 2002

Project No. 6426

PALEOSEISMIC INVESTIGATION OF THE SAN ANDREAS FAULT ZONE IN PORTOLA VALLEY, CALIFORNIA

USGS NEHRP Award No. 01HQGR009

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ABSTRACT

The primary goal of this investigation was to expand on previous investigations in central Portola Valley and refine, to the extent possible, the late Holocene history of ground rupturing events on the Peninsula segment of the San Andreas fault zone. A total of five (5) backhoe trenches between 7.5 feet (2 m) and 14 feet (4 m) deep and totaling about 773 feet (236 m) were excavated and logged on the Spring Ridge and White properties, and fifteen (15) radiocarbon ages were obtained. Our investigation found no suitable channels or other stratigraphic conditions in the alluvial and fluvial units exposed in the trenches for resolving individual slip events. The N20-25W-trending, short, left-stepping, en-echelon fault zone associated with the active Woodside trace on the Spring Ridge property continues northwest to near the property line and then bifurcates. A zone of (pre-1906) faulting (Riedel shears) continues more northerly and eventually dies out on the White property. Another zone of faulting (including 1906) projects about N38W into the White property, where the tectonic signature of the 1906 ground rupture is muted in the young section of sediments in the central portion of the valley. Several pre-1906 events were identified in the trenches, but all are older than about 1006 AD and are insufficiently constrained to resolve individual events. At least 2, and probably 3, 1906-type events, including the penultimate event and the probable 1838 event, are missing from the record. No evidence for the Trancos trace was encountered in sediments spanning the last half of the Holocene, and if present, the trace is considered to be inactive. The findings of this investigation are consistent with the tectonic model for central Portola Valley as a Holocene, pull-apart basin at a local right (releasing) step or bend in the Woodside trace, with much of the sediment derived from ancestral Corte Madera Creek diverted by movement on the Woodside trace about 1000 years ago.

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PALEOSEISMIC INVESTIGATION OF THE SAN ANDREAS FAULT ZONE IN PORTOLA VALLEY, CALIFORNIA

1.0 INTRODUCTION

Large historic earthquakes occurred on the San Francisco Peninsula segment of the San Andreas fault in 1906 and 1838 (Hall and others, 2001). A number of paleoseismic investigations on the San Francisco Peninsula indicate ground rupturing earthquake events have occurred during the Holocene on one trace of the Peninsula segment, locally known as the Woodside trace. However, prehistoric late Holocene paleo-earthquakes have not been identified and dated with confidence. Based on previous investigations, the well located Woodside trace steps or bends to the right in central Portola Valley, creating a pull-a-part basin in which Holocene alluvial, fluvial and marsh deposits have accumulated.

The primary goal of this investigation is to expand and refine, to the extent possible, the late Holocene history of ground rupturing events on the Peninsula segment of the San Andreas fault. This investigation expands upon investigations previously conducted on property known as Spring Ridge (Wright and others, 1999), extending them further northwest and into the central portion of the pull-apart basin on property formerly known as the Jelich Ranch. The former Jelich Ranch occupies a depositional environment more conducive for preserving a record of late Holocene earthquakes. The timing of this investigation was critical because of the pending sale in 1999 of the Jelich Ranch property for development, which would preclude further paleoseismic investigations on that property. The Jelich Ranch property was sold in late 1999, prior to award of this investigation, and is now known (and herein referred to) as the White property.

2.0 BACKGROUND INFORMATION

In central Portola Valley, the Peninsula segment of the San Andreas fault zone is interpreted as consisting of two mapped, subparallel northwest-trending fault traces, referred to as the Woodside and Trancos traces (Dickinson, 1970). As shown on the Town of Portola Valley (Town) Geologic Map, the Woodside trace is located on the southwest side of the “rift” valley and the Trancos trace is located on the northeast side, adjacent to Portola Road. The Woodside trace is the local trace of the San Andreas fault that ruptured the ground surface during the 1906 earthquake. The location of the 1906 surface rupture in the Portola Valley area has been documented by Tabor (1907), Lawson (1908), Dickinson (1970), and Pampeyan (1970), and more recently by Wright and others (1999). Lawson (1908) described and photographed the fault rupture across Portola Road, about ¼ mile (0.4 km) north of the study area (Plate 1 and Figure 1) and to the southeast across Alpine Road near the present Portola Valley Ranch subdivision. The location of the 1906 ground rupture across Alpine Road has been confirmed by Dr. Carol S. Prentice of the U.S. Geological Survey (USGS) and Dr. N. Timothy Hall of Geomatrix Consultants (Geomatrix), as part of preparation of a strip map of the San Francisco Peninsula segment of the San Andreas fault (USGS Award Nos. 14080001G2081 and 143495G2581).

In the central Portola Valley area, the Trancos trace is mapped as lying subparallel to, and up to several hundred feet northeast of, the Woodside trace. The Trancos trace was originally identified by Dickinson (1970), based primarily on his interpretation of topographic and tonal lineaments on 1963 and 1968 aerial photographs. As mapped by Dickinson and shown on Town maps, the Trancos trace/lineament is continuous along the northeast side of the central Portola Valley and along the northeast side of The Sequoias (a retirement community) further southeast. As seen on 1941 aerial photographs prior to the development of The Sequoias (Plate 1), the Trancos lineament in central Portola Valley locally consists of two subparallel topographic/tonal lineaments up to about 80 feet (24 m) apart. On the White property, the traces/lineaments closely coincide with fill slopes associated with historical grading activities (Plate 2). To the southeast, the northwest-trending Trancos lineament lies along the northeast side of central Portola Valley and ends against the more westerly striking structure of the hills underlying The Sequoias site. Further south, the lineament steps to the northeast into the drainage of Corte Madera Creek. There is no indication that ground rupture occurred on or in the immediate vicinity of the Trancos trace during the1906 earthquake.

3.0 SUMMARY OF PREVIOUS WORK

Several trenching investigations to assess the location and activity of the Woodside and Trancos traces have been conducted in the study area. The locations of these investigations are shown on Plate 1 and include (from north to south):

- the Town Center (formerly Portola Valley Elementary School) located on the northwest and investigated in 1976 and 1977;
- the Spring Down Equestrian Center (SDEC) located on the northwest and investigated in 1991 and 1992;
- the Spring Ridge property located on the southeast and investigated in 1999; and
- The Sequoias (on Windy Hill Open Space property) located on the southeast and investigated in 1975 and 1999.

3.1 WOODSIDE TRACE

Woodward-Clyde Consultants (WCC, 1976a, 1976b, and 1977) excavated four (4) trenches at the Town Center site (Plate 1) to investigate the trend and location of the Woodside trace as mapped by Pampeyan (1970) and Dickinson (1970). Trench 5, located just south of Portola Road, encountered an approximately 22-foot-wide zone of N20-35E trending shears. The gently southwest dipping surficial deposits within the shear zone were back-rotated and down-dropped (southwest side down) across a N33E, 85W shear. No evidence of shearing was reported in WCC Trenches 1, 4, and 6, although an “anomalous zone” reportedly was encountered in Trench 1.

Harlan Tait Associates (HTA, 1991 and 1992) interpreted a subtle west-facing monocline present in their Trenches 1 and 6 excavated on the SDEC to be the signature of the 1906 rupture (Plate 1). Based on their reevaluation of the WCC trench logs, HTA (1991 and 1992) speculated that that the 1906 rupture projected approximately N35W from HTA Trenches 1 and

6, through the anomalous zone in WCC Trench 1, and immediately to the west of WCC Trench 5. Further south on the Spring Ridge property, Wright and others (1999) identified the Woodside trace in their Trenches T1 through T3.

Review of the above-mentioned previous work during this investigation suggests that there is no compelling evidence of the Woodside trace extending southeast from the location of the photo-documented 1906 ground rupture across Portola Road (Figure 1) to the White property along, or northeast of, the HTA (1991 and 1992) projection. No evidence of faulting was encountered in WCC (1976a, b and 1977) Trenches 4 and 6, which lie along the HTA projection. The north-trending shear zone in WCC Trench 5, also apparent in Figure 1, is consistent with Riedel shears, or a left-stepping shear zone. The active N25W-trending Woodside trace identified in Trenches T1 through T3 excavated on the Spring Ridge property (Wright and others, 1999) also is a left-stepping shear zone with north-trending Riedel shears on the west side. The northeast-trending shear zone in WCC Trench 5 could project southwest, past the southwest end of WCC Trench 6.

Calibrated (2 sigma) radiocarbon ages (in years before present [BP]) from charcoal samples at, and near, the top of a marsh/lake deposit encountered in WCC Trenches 1 through 4 (1976a, b) are 655 to 931 BP and 1835 to 2312 BP, respectively. This marsh/lake deposit was correlated with a stratigraphic unit (Unit 6) exposed at/near the bottom of Spring Down Trenches 1 and 6 (HTA, 1991 and 1992). The WCC (1976a, b) radiocarbon ages suggest that the age of the deposits exposed in HTA Trenches 1 and 6, which stratigraphically overlie Unit 6, are less than about 655 BP. This time interval suggests that at least 1, if not 2 or more, pre-1906 ground rupturing events should be present in HTA (1991 and 1992) Trenches 1 and 6 if the Woodside trace, in fact, crosses these trenches. The subtle monocline present in HTA Trenches 1 and 6 does not appear to be a substantial enough structure to represent a multiple-ground-rupture signature and, therefore, the Woodside trace may pass further west than previously interpreted. If the Woodside trace is located further west on the Town Center, SDEC, and White properties than previously mapped, the required left-step between Portola Road and Spring Ridge would be inconsistent with the historic observations of the 1906 ground rupture by Tabor (1907), who wrote *"Through the Portola Valley area, and for about 3 miles northwest of Woodside, the fracture runs in a continuous and almost straight line."*

3.2 TRANCOS TRACE

WCC (1976a, b and 1977) concluded that the Trancos trace, if present, was located northeast of the end of their Trench 3 excavated at the Town Center. HTA (1991 and 1992) found no evidence of the Trancos trace or for the origin of associated lineaments encountered in their Trench 3 excavated on the SDEC (Plate 1). However, in consultation with the office of the Town Geologist at that time and to be conservative, a postulated Trancos trace with setbacks was shown on the SDEC, coinciding with a topographic step in the northeastern portion of the property and projecting to a zone of N5E to N5W striking, vertical, thin clay-filled cracks, with no vertical offsets of units logged in the lower units in northeastern end of WCC Trench 3.

WCC also investigated the Trancos trace at The Sequoias in 1975 (Plate 1). WCC identified a shear zone entirely in Eocene-age (53-36 million years ago) bedrock in Trench 2 (WCC, 1975;

personal communication with Al Ridley, WCC, 10/91). Pacific Geotechnical Engineering (PGE, 1999) found no evidence of the Trancos trace or for the origin of associated lineaments in a recent trench excavated north of the Windy Hill Open Space parking lot for The Sequoias. However, the PGE (1999) trench did not extend far enough northeast to completely investigate all of the possible locations of the Trancos trace/lineaments, including the northwest projection of the bedrock shear zone encountered in WCC Trench 2 (1975). Finally, no evidence for the Trancos trace was encountered in trenches excavated across the mapped trace in southern Woodside, northwest of Portola Road (Connelly, 1997; Wood, 1987).

4.0 SCOPE OF INVESTIGATION

As previously noted, at the time the proposal for this investigation was submitted, the sale of the Jelich Ranch was pending. Prior to the award of this investigation, the property was sold and Geomatrix was awarded a proposal to conduct an Alquist-Priolo (AP) Fault Zone hazard investigation of the Woodside and Trancos traces for planned development of the property, as required by the State of California and the Town. The initial scope of work developed for the White property (formerly Jelich Ranch) included five (5) trenches, including: Trench T-1 located across the Trancos trace on the Spring Ridge property, Trenches T-2A and T-2B located across the Trancos trace along the northern boundary of the White property, Trench T-3 located across the Woodside trace on the White property, and Trench T-4 located on the Spring Ridge property. At that time it was anticipated that proposed Trench T-4, located at the northwest margin of the Spring Ridge property would be the focus of this paleoseismic investigation, should it be awarded. The investigation for the White's proceeded with the excavation of Trench T-3. On award of this investigation, Trench T-4 was excavated next. Based on the findings of Trench T-4, Trench T-5 and subsequently Trench T-6 were excavated to follow features to the north on the White property. Trench T-1 was excavated subsequent to Trench T-5 and prior to Trench T-6. Based on the findings from Trench T-1, proposed Trenches T-2a and 2b were not excavated.

The final scope of work, therefore, consisted of:

- the excavation and logging of three backhoe trenches (T-3, T-5, and T-6) across the Woodside trace on the White property;
- the excavation and logging of one backhoe trench (T-4) across the Woodside trace on the Spring Ridge property;
- the excavation and logging of one backhoe trench (T-1) across the mapped Trancos trace on the Spring Ridge property;
- evaluation of the trench data, including the results of radiocarbon analyses performed by Lawrence Livermore National Laboratory (LLNL) for the USGS (BAPEX); and
- preparation this report.

Trench T-3 was excavated and logged between October 23 to 27, 2000. Trench T-4 was excavated and logged between November 15 to 29, 2000. Trench T-5 was excavated and logged between December 12 to 21, 2000. Trench T-1 was excavated and logged between January 1 to 5, 2001. Trench T-6 was excavated and logged between January 8 to 23, 2001.

The trenches were logged under the direction of Todd A. Crampton (Project Geologist), with the assistance of Hans F. Abramson (Staff Geologist), Todd N. Loar (Staff Geologist), Brian J. Thompson (Project Geologist), all with Geomatrix, and Phillip A. Frame, Consulting Geologist.

Because of access constraints placed on the investigation by the landowners, site visits by interested professionals were severely restricted. However, representatives of the Town visited all trenches, and representatives of the USGS visited Trenches T-1 and T-4 through T-6. A representative of LLNL visited Trench T-6. After completion of Trench T-6, no further work was permitted on the White property.

The NEHRP award covered all costs associated with Trench T-4 and the preparation of this report except for radiocarbon analyses. The costs of radiocardon analyses were covered by the USGS (BAPEX). The Whites covered all other costs.

All of the trenches excavated on the White property were backfilled in lifts and compacted with a vibrating tamper. Trenches on the Spring Ridge property were backfilled and compacted with the backhoe bucket and by wheel-rolling with the backhoe.

5.0 FINDINGS

The findings of our investigation are summarized on Plates 1 and 2. The locations of the trenches are shown on Plates 1 and 2, and the trench logs are shown on Figures 2 through 6. Descriptions of the geologic units encountered in the trenches are presented in Table 1. Although the units are numbered from lowest (bottom) to highest (top) in all the trenches, same-numbered units are not necessarily correlated. The units in Trench T-1 have not been correlated with units in the rest of the trenches. The units in Trenches T-4 to T-6 are correlated and same-numbered units are equivalent. The units in Trench T-3 have not been correlated on the logs with units in the rest of the trenches. However, we correlate Unit 1 in Trench T-3 with Unit 5 in Trenches T-4 to T-6, and Units 2 to 4 in Trench T-3 with Units 6 and 7 in Trenches T-4 to T-6. A summary of calibrated radiocarbon ages using the Calib 4.3 program of the University of Washington is presented in Table 2. Copies of the LLNL radiocarbon data sheets and copies of the calibrated data sheets are presented in the Appendix. A brief summary of the geologic units and structural relationships encountered in the trenches is provided below.

<u>Trench T-1</u> (Figure 2a and 2b): Trench T-1 was about 146-feet-long (44 m) and up to about 13.5-feet-deep (4 m). It was located on the Spring Ridge property to cover the unexplored gap left by PGE (1999), and to cross the two mapped traces/lineaments of the Trancos trace on the Spring Ridge property (Plate 1). The mapped traces/lineaments correspond on the ground to two subparallel, linear depressions that cross the trench at about Stations 45 and 110. The trench exposed alluvial fan deposits consisting primarily of silt and clay with lesser amounts of sand and gravel to the depth explored. The upper approximately 1.5 feet (0.5 m) is within the plow zone. The alluvial deposits are essentially flat lying to gently dipping, and laterally continuous. A paleosol is developed on the top of Units 1 through 6. There is a slight angular

unconformity between Units 1 and 2 and the overlying units in the northeastern end of the trench. Southwest of about Station 52 (South Wall), Units 2 through 7 form a broad downwarp with the low point centered roughly between the two lineaments. The ground surface between the lineaments, however, forms a broad (convex up) topographic high that is centered roughly over the low of the down warp. A gravelly channel associated with Unit 2 is present at about Station 50 (South Wall), and a gravelly channel associated with Unit 3 is present at about Station 17 (South Wall). An apparently man-made, filled ditch (?) is present between about Stations 10 and 19 (South Wall). The base of Unit 4 southwest of about Station 61 (South Wall), which grades more gravelly, has an irregular basal contact. However, similar irregularities are not present along the contacts above and below at his contact, and the irregularities are interpreted to be erosional in origin. No groundwater was encountered in the trench.

No evidence of faulting, significant ground deformation, or liquefaction is present in Trench T-1, nor are there any anomalous structures or features that could account for the origin of the lineaments. Two radiocarbon ages were obtained from charcoal samples from Trench T-1. A sample from near the top of Unit 1 at about Station 33 (South Wall) yielded a calibrated (2 sigma) radiocarbon age of 4837 to 5441 BP, and a sample from near the bottom of Unit 2 at about Station 46 (South Wall) yielded a calibrated (2 sigma) radiocarbon age of 4837 to 5258 BP. These ages are stratigraphically reasonable and consistent, and also are consistent with radiocarbon ages obtained from samples from stratigraphically younger deposits in the southeastern end of the PGE trench (1999).

<u>Trench T-3</u> (Figures 3a, 3b and 3c): Trench T-3 was about 284-feet-long (87 m), up to about 7.5-feet-deep (2 m), and was located to cross the southeast projection of the Woodside trace located on the Spring Down Equestrian Center property (HTA, 1991 and 1992; Plates 1 and 2). This projection crosses the trench at about Station 192. The trench exposed organic-rich marsh deposits (Unit 1), and fluvial deposits consisting primarily of silt to sand with local fine gravel and clean fine sand stringers (Units 2 and 3), and gravelly deposits (Unit 4). Unit 1 in Trench T3 is correlated with Unit 5 in Trenches T-4 to T-6, and Units 2 to 4 in Trench T-3 with Units 6 and 7 in Trenches T-4 to T-6. We provisionally correlate Unit 1 and Units 2 to 4 in Trench T-3 with Unit 6 and Units 1 to 4, respectively, in the Spring Down Trenches (HTA, 1991 and 1992; Plate 1).

The upper approximately 1.5 feet (0.5 m) is within the plow zone. The fluvial deposits are exposed throughout most of the trench and overly the marsh deposits northeast of about Station 195 (South Wall). A paleosol is developed on the top of Units 1 and 2 southwest of about Station 210 (South Wall). The top of the marsh deposits is planar, sharp, and dips gently to the southwest. Southwest of about Station 158 (South Wall), the base of the fluvial deposits overlying the marsh deposits consist of clean fine sand deposits with local fine gravel stringers up to 0.9-feet-thick (0.3 m; Unit 2a). The upper contact is sharp and locally convex (dome-shaped) and the basal contact is sharp and planar. Similar clean fine sand deposits (Unit 3a) occur at the base of Unit 3 between about Stations 253 and 270 (South Wall), and the lower part of these deposits contains significant amounts of detrital charcoal.

The entire stratigraphic sequence is disrupted between Stations 243 and 252 on both walls of the trench, as most prominently displayed by the paleosol at the top of Unit 2, which steepens across this interval to form a west-facing monoclinal feature. The across-trench trend of this feature is approximately N25W. The relief on the top of the paleosol across this zone is about 1.5 feet (0.5 m), and the paleosol continues to slope gently down to the west. Between Stations 243 and 252, the paleosol is pinched, warped, and locally broken, as are interbeds and stringers within Units 2 and 3. A charcoal stringer appears to be offset about 0.3 feet (0.1 m; down-on-the-west) at about Station 244 on both walls of the trench. However, no discrete faults or clay-lined shears were observed in this interval. Groundwater was encountered on both sides of the disrupted zone. Projection of groundwater levels across the disrupted zone suggests that the groundwater level southwest of the disrupted zone is about 1.5 feet (0.5 m) lower than northeast of the zone.

Although the disrupted stratigraphic sequence between Stations 244 and 252 can be interpreted to reflect deformation due to earthquake shaking or faulting, we interpret the disruption to be the result of past faulting, most likely during the 1906 event. We speculate that the clean fine sand deposits (Units 2a and 3a) may be liquefaction features (i.e., sand boils) related to pre-1906 earthquake events.

A detrital charcoal sample from Unit 1 at about Station 34 (South Wall) yielded a calibrated (2 sigma) radiocarbon age of 974 to 1227 BP.

<u>Trench T-4</u> (Figures 4a and 4b): Trench T-4 was excavated across the Woodside trace on the adjacent Spring Ridge property, about 100 feet (30 m) northwest of Trench T3 excavated previously by Wright and others (1999; Plates 1 and 2). Trench T-4 was about 120-feet-long (37 m) and up to about 11.5-feet-deep (3.5 m). The trench exposed alluvial fan deposits (Units 1 through 5) in the eastern part of the trench, overlain by fluvial deposits (Units 6 and 7) of the young Sausal Creek fan in the western part of the trench. The upper approximately 1.5 feet (0.5 m) of the trench exposure is within the plow zone. A paleosol is developed on the top of Units 3, 5 and 6. The contact between the fluvial and alluvial units is an angular unconformity. Groundwater was not encountered in the trench.

A zone of faulting is clearly present between about Stations 52 and 86 (South Wall) that is similar in width and character to the zone that was present in the nearby Trench T3 (Wright and others, 1999). The main zone of faulting is located between about Stations 62 and 77 (South Wall), and is predominantly within the alluvial deposits. Across this zone the units appear to be warped down-to-the-west, and are offset down-to-the-west across individual “shears”, most of which appear to extend up to the plow zone and represent 1906 ground ruptures. Across this zone the paleosol on the top of Unit 3 has an apparent total vertical offset of at least 6 feet (2 m). The main “shear” bounding this zone on the west has an across-trench strike of N38W, while the average across-trench strike of the other “shears” in this zone is N6W.

Other “shears” between about Stations 61 and 66 and 80 and 86 (South Wall), appear to terminate upward within Unit 4 before reaching the base of Unit 5. Two “shears” between about Stations 52 and 54 (South Wall) appear to terminate upward within Unit 5 before reaching the base of Unit 7. One “shear” at about Station 80 (South Wall) offsets the base of

Unit 3 and appears to terminate within Unit 3. These "shears" represent pre-1906 ground rupturing earthquake events, but their timing is poorly constrained.

Nine (9) radiocarbon ages were obtained from detrital charcoal samples from Trench T-4. A summary of the calibrated (2 sigma) radiocarbon ages (BP) for units in Trench T-4 is presented below.

Alluvial Deposits:

Unit 1	4242 to 4509 BP (middle)
Unit 2	4151 to 4418 BP (near top)
Unit 3	5407 to 5467 BP (middle)
Unit 4	2363 to 2747 BP (middle)

Fluvial Deposits:

Unit 6	304 to 478 BP (top)
Unit 7	304 to 478 BP (base)
	317 to 513 BP (base)
	319 to 518 BP (lower)
	315 to 506 BP (upper)

These ages are stratigraphically reasonable and reasonably consistent. These ages also are consistent with the radiocarbon ages obtained from nearby Trench T3 (Wright and others, 1999), and the finding in that report that deposition on the older fan in the southeast portion of the valley ceased after about 900 years when the modern Sausal Creek began to down cut along the southwest margin of the fan (Plate 1).

<u>Trench T-5</u> (Figure 5a and 5b): Trench T-5 was excavated on the south side of the White property across the projection of the more northerly trending shears encountered in the fault zone exposed in Trench T-4 (Plates 1 and 2). The trench was about 140-feet-long (43 m), up to about 13-feet-deep (4 m), and exposed the same stratigraphic sequence that was present in Trench T-4. A paleosol is developed on the top of Units 1 through 6. Groundwater was at the bottom of the trench.

Between about Stations 22 and 29, the stratigraphy of Units 1 through 3 appears to be disrupted by faulting, particularly on the southwest wall. The average across-trench strike of this disrupted zone is N6W. No clay seams or similar features typical of shears are present, and it is possible that this deformed zone could be due to depositional and erosional processes, and/or deformation due to earthquake shaking. However, it is our opinion, as well as the consensus of others that studied the trench, that the units are faulted. Figures 5a and 5b show our interpretation of the faulting. Bounding "shears" on the southwest wall (Figure 5a) define a down-dropped block, back-rotated to the east, with a maximum apparent vertical offset of about 1-foot (0.3 m) on the top and bottom of Unit 2. Individual "shears" appear to terminate within Units 1-4 and one "shear" may extend into the base of Unit 5. However, no "shears" can be convincingly interpreted to offset the base of Unit 5, and evidence for 1906 ground rupture is not present in the trench. These "shears" represent pre-1906 ground rupturing earthquake events, but their timing is poorly constrained.

Three (3) radiocarbon ages were obtained from detrital charcoal samples from Trench T-5. A summary of the calibrated (2 sigma) radiocarbon ages (BP) for units in Trench T-5 is presented below.

Alluvial Deposits:

Unit 4	2750 to 2866 BP (near base)
Unit 5	2362 to 2744 BP (near base)

Fluvial Deposits

Unit 7	316 to 510 BP (base)

Trench T-6 (Figure 6a and 6b): Trench T-6 was excavated on the White property across the northward projection of the N6W-trending fault zone mapped in Trench T-5 (Plates 1 and 2). The trench was about 83-feet-long (25 m) and up to about 14-feet-deep (4 m), and with the exception of Unit 6, exposed the same stratigraphic sequence that was present in Trenches T-4 and T-5. A paleosol is developed on the top of Units 1 through 5. The units in Trench T-6 are laterally continuous and dip gently to the west, and have relatively planar contacts. Groundwater was at the bottom of the trench.

No evidence of faulting, significant ground deformation, or liquefaction was observed in Trench T-6. The "shears" mapped in Trench T-5 die out before reaching Trench T-6.

6.0 CONCLUSIONS AND DISCUSSION – TECTONIC MODEL

The significant conclusions of this investigation are:

1. The N20-25W-trending, short, left-stepping en-echelon fault zone associated with the active Woodside trace on the Spring Ridge property (Wright and others, 1999) continues northwest to the vicinity of Trench T-4. In Trench T-4, the fault zone apparently bifurcates, with a zone of (pre-1906) faulting (Riedel shears) continuing more northerly through Trench T-5 and dying out before reaching Trench T-6, and another zone of faulting (including 1906) projecting about N38W, toward the northwest end of Trench T-3 (Plate 2);
2. The tectonic signature of the 1906 ground rupture is muted in the section of young basin sediments exposed in Trench T-3,
3. No suitable channels or other stratigraphic conditions are present for resolving individual slip events;

4. The 1906 event is present in Trenches T-4 and T-5. Several pre-1906 events are present in the trenches, but all are older than about 1006 AD. At least 2 and probably 3, 1906-type events, including the penultimate event, and the probable 1838 event, are missing from the record exposed in Trenches T-4 and T-5. However, the record of paleoseismic events in the trenches is insufficiently constrained to resolve individual events; and
5. No evidence for the Trancos trace or associated lineaments was encountered in Trench T-1. This trace, if present at depth, is considered to be inactive. These findings are consistent with the tectonic model of the area developed by the authors (most recently Hall and others, 2001), and summarized below.

6. The findings of this investigation are consistent with the previous tectonic model for central Portola Valley as a small, Holocene pull-apart basin at a local right (releasing) step or bend in the Woodside trace. The findings are also consistent with previous findings that deposition on the older fan in the southeast portion of the valley ceased after about 1000 years when the modern Sausal Creek began to cut down along the southwest margin of the fan, and with previous speculation that the source of the alluvial deposits in the fan in the southeast portion of the valley is the ancestral Corte Madera Creek that was diverted by movement on the Woodside trace about 1000 years ago.

6.1 TECTONIC MODEL

The "rift valley" of the San Andreas fault zone in the study area is shown diagrammatically on Figure 7. Extending northwest through the Town of Woodside from about Alpine Road in Portola Valley, the fault zone has a fairly consistent trend of about N35W, a width of about 800 to 900 feet (245 to 275m), and relatively linear margins defined by the front of the Santa Cruz Mountains on the southwest and Sausal Creek and other drainages on the northeast. In central Portola Valley the "rift zone" has a left-step, and the zone extending from The Sequoias southeast to Alpine Road is more complex, with boundaries largely defined by the channel of Corte Madera Creek and the upper (drowned) reach of Sausal Creek. Between these channels, the fault zone consists of a series of west-northwest trending bedrock highs.

Between Alpine Road and The Sequoias, the active Woodside trace is located on the southwest margin of the fault zone, while northwest of Portola Road the active Woodside trace is located along the northeast margin of the zone. Between these two areas the Woodside trace takes a right (releasing) step or bend of about 500 feet (~150m) of fault-normal separation. This step or bend results in local crustal extension, and has been responsible for forming a small pull-apart basin (Aydin and Nur, 1982; Hempton and Dunne, 1984; Hempton and Neher, 1986; Mann and others, 1983; ten-Brink and Ben-Avraham, 1989; EERI, 2000). A smaller right step or bend in the active trace occurs along old Canada Road north of Woodside (Wright and others, 1999).

A boring in this basin on the Spring Down Equestrian Center (HTA, 1992, Boring 2) encountered fluvial, marsh/lake, alluvial and colluvial sediments to the bottom of the hole at

89.5 feet (~27 m). Radiocarbon analysis of a detrital charcoal samples from near the bottom of this boring at 88.9 feet (27 m) yielded calibrated (2 sigma) radiocarbon ages of 13,150 to 13,782 BP and 6991 to 7306 BP (Heingartner, 1995), documenting relatively rapid subsidence and concurrent sedimentation within the basin throughout much of the Holocene. This is consistent with other evidence that Holocene activity on the San Francisco Peninsula segment of the San Andreas fault zone has occurred on the same, single trace that is locally called the Woodside trace (Hall, 1984; Hall and others, 2001). The model does not require a through-going, near-surface connection between segments of the active Woodside trace across the basin, which is consistent with lack of a clear fault signature in trenches. The muted fault signature across the basin may also reflect the distributed nature of shearing within the thick section of young, saturated basin sediments.

As noted above, the "rift zone" from The Sequoias southeast to Alpine Road consists of a series of west-northwest trending bedrock highs. The tectonic model (Figure 7) can be used to explain these highs if pre-Holocene slip was accommodated on a trace that stepped left in central Portola Valley. Compression associated with a left (restraining) step or bend on such a trace could have produced the bedrock highs, and could account for the linear southwest margin of the Portola Valley/Woodside "rift zone" to the northwest. A fault was mapped along this margin to the northwest on previous versions of the Town of Woodside Geologic Map, but was removed from the map by the then Town Geologist, because no evidence of faulting was encountered in trench investigations along the trace. However, the southwest margin of the "rift valley" in Woodside is covered by thick colluvial and alluvial fan deposits, and an inactive trace could be present at depth. Our tectonic model essentially requires the presence of an inactive trace in the Portola Valley/Woodside area, where this trace is buried beneath Holocene sediments at depths below the excavation capability of a standard backhoe. In the hilly terrain southeast of Alpine Road where bedrock is present at or close to the ground surface, the mapped Trancos trace is locally present as a bedrock fault (HTA, 1990).

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Tables

TABLE 1

TRENCH UNIT DESCRIPTIONS

Paleoseismic Investigation of the San Andreas Fault Zone
Portola Valley, California

TRENCH 1:

Unit 1:
Sandy clay with clayey sand and gravel (CL-SC); mottled dark yellowish brown (10YR 4/6) and grayish brown (10YR 5/2); sandy clay is very stiff; sand and gravel is dense; dry to moist; has local medium sand lenses; base of unit is gravelly west of station 42; gravels are moderately well graded and subangular to subrounded; gravels consist predominantly of deeply weathered sandstone and claystone; contains local roots; top of unit is a paleosol with few scattered pebbles; paleosol is mottled dark reddish brown (5YR ¾) and dark gray (5YR 4/1).

Unit 2:
Sandy silt to sandy clay (CL-ML); mottled dark yellowish brown (10YR 4/6) and grayish brown (10YR 5/2); stiff; moist; has local fine pores/voids; contains a small, coarse sand channel at Station 50 (South Wall); top of unit is a paleosol mottled dark reddish brown (5YR ¾) and dark gray (5YR 4/1).

Unit 3:
Sandy silt (ML); mottled dark yellowish brown (10YR 4/6) and dark gray (10YR 4/1); stiff; dry; has local fine pores/voids; has local roots; base of unit has a small coarse sand and gravel channel near east end of trench; locally bioturbated.

Unit 4:
Sandy clay with clayey gravelly sand (CL-SC); sandy clay is very dark gray (5YR 3/1); gravelly sand is mottled very dark grayish brown (10YR 3/2) and dark yellowish brown (10YR 4/6); very stiff; has local discontinuous fine gravel stringers; a gravelly sand lense forms the base of the unit west of Station 60 (South Wall); has strong, subvertical gley mottling near east end of trench; has local filled burrows; top of unit is a paleosol mottled dark gray and brown.

Unit 5:
Sandy silt (ML); very dark gray (5YR 3/1); stiff; moist; has local, scattered fine gravel near basal contact; top of unit is a charcoal rich paleosol mottled reddish brown (5YR 4/4); unit is locally bioturbated.

Unit 6:
Silty sand to sandy silt (SM-ML), mottled dark yellowish brown (10YR4/6) and dark grayish brown (10YR4/2), moderately stiff, moist; has local stringers of fine gravel/coarse sand; has local charcoal; has an apparent burn pocket at Station 125 (South

Wall, and on opposite wall at Station 87); top of unit is a paleosol mottled very dark grey (5YR3/1); unit is locally bioturbated.

Unit 7:
Silty sand to sandy clay (SM-CL); dark brown (7.5YR ¾) to very dark gray (10YR 3/1) to black (10YR 2/1); firm to soft; moist; has local coarse sand stringers; pervasively bioturbated; has abundant roots; merges upward with modern A horizon; plowed up to a depth of about 1.5 feet.

TRENCH 3

Unit 1:
Silty Clay (CL-CH); very dark gray (5YR 3/1) and grayish brown (2.5YR 3/2) to black (5YR 2.5/1) with local reddish mottling; firm to stiff; moist; has local fine gravel stringers and fine roots; becomes sandy to the west; contains local filled burrows; locally has a porous texture; top of unit is a black paleosol with abundant charcoal; paleosol contains local reddish burn pockets and is locally bioturbated.

Unit 2a:
Fine sand (SP); yellowish brown (10YR 5/8) moderately dense, moist fine-grained sand with local fine gravel stringers; unit contains trace fines; contact with underlying paleosol is planar and sharp; upper contact is convex upward and sharp; relatively dark silty section overlying unit is a possible paleosol; [liquefied sands/sand boils?].

Unit 2b:
Silty fine sand (SM); yellowish brown (10YR 5/8) to dark yellowish brown (10YR 4/6) with gray and yellowish red (orange) mottling; moderately dense; moist to dry; contains local coarse sand lenses and fine gravel stringers; coarse sands and gravels are subrounded; has local planar cross bedding; has local charcoal; unit has abundant krotovina; has local fine roots; unit generally fines too the west; west of station 212 the top of Unit 2 is a paleosol overlain by Unit 3; east of Station 212 (South Wall) paleosol merges with modern A horizon; modern A horizon is pervasively bioturbated and plowed up to a depth of about 1.5 feet.

Unit 3:
Sandy silt to silty sand (ML-SM); yellowish brown (10YR 5/8) to dark yellowish brown (10YR 4/6); moderately dense; moist to dry; has local clean sand lenses and fine gravel stringers; has local charcoal and fine roots; locally bioturbated.

Unit 4:
Gravelly sand with silt (SW); gray to brown; moderately dense to loose; dry; gravels are moderately well graded and subrounded; has local krotovina.

TABLE 1 (continued)

TRENCH UNIT DESCRIPTIONS

TRENCHES 4 AND 5

Unit 1:
Silty to clayey fine sand with gravel (SC); mottled yellowish red (5YR 4/6) and gray (5YR 5/1); medium dense; moist; has local gravel lenses and stringers; gravels are fine and subrounded; contains few scattered subrounded pebbles; upper part of unit is generally oxidized; has numerous subvertical gleyed streaks (some contain fine roots); in Trench 5, top of Unit 1 is a dark reddish brown (5YR 3/2) paleosol.

Unit 2:
Sand with gravel (SW); reddish brown (5YR 4/3); locally oxidized red (2.5YR 5/8); medium dense; moist; contains gravel lenses and stringers; gravels are well graded and subrounded to subangular; gravels consist mainly of deeply weathered sandstone and siltstone; sands are locally poorly graded, particularly at base of unit; top of unit is a paleosol that contains local charcoal fragments and has few scattered pebbles; entire unit fines upward.

Unit 3:
Silty sand with gravel (SM); strong brown (7.5YR 5/8) to dark brown (7.5YR 3/2); medium dense; moist; gravels are scattered and well graded; gravels consist mainly of deeply weathered sandstone and siltstone, with minor shale and red claystone; upper part of unit is a loamy paleosol; paleosol has local sand filled burrows.

Unit 4:
Silty to clayey sand with gravel (SC-SM); brownish yellow (10YR 6/6) to brown (7.5YR 4/6); dense to medium dense; dry to moist; contains coarse sand and gravel lenses, particularly near the base of the unit; upper part of unit contains discontinuous gravel stringers; gravels are generally well graded and subrounded; entire unit fines upward; top of unit is capped by a very dark gray (10YR 3/2) organic rich loamy soil that contains abundant filled animal burrows and fine roots.

Unit 5:
Sandy clay to clayey sandy silt (CL-ML); lower part of unit is very dark grayish brown and upper part is very dark gray to black (10YR 3/1-2/1); stiff; moist; contains few scattered pebbles and local fine gravel; Trench 4 has an apparent fire-baked sandstone cobble at Station 60 (South Wall); gravels are angular to subangular; sands are fine to very fine; contains local fine roots; upper part of unit has abundant fine voids/pores; upper contact is locally burrowed; entire unit is a thick paleosol.

Unit 6:
Sandy gravel with silt (GW); gray to brown; dense; dry; sands locally exhibit planar cross bedding; gravels are well graded and subrounded to well rounded; contains few local cobbles; gravels are predominantly deeply weathered sandstone and siltstone; top of unit is a silty, very dark gray (7.5YR 3/1) paleosol; paleosol contains few scattered pebbles and local charcoal.

TRENCH UNIT DESCRIPTIONS

Unit 7:
Sand and sandy gravel (SP-GW); sands are dark yellowish brown (10YR 4/4); gravels are brown and gray; medium dense; dry; sands locally exhibit planar cross bedding; gravels are well graded and subrounded to well rounded; locally gravels are tabular; contains few local cobbles; gravels are predominantly deeply weathered sandstone and siltstone; has local charcoal and fine roots; upper part of unit is pervasively bioturbated; unit is capped by modern A horizon, which is pervasively bioturbated and reworked (plowed) to a depth of about 1.5 feet..

TRENCH 6:

Unit 1:
Sandy gravel and silty clay (GW-CL); sands and gravels are gray to brown; moderately dense to loose and moist; silty clay is firm and moist; gravels are well graded; coarse gravels and cobbles are subangular to subrounded; fine gravels are subrounded to rounded; gravels are primarily sandstone and siltstone; silty clay is mottled gray (7.5YR 5/1) and brown (7.5YR 5/4); locally has minor sand and scattered fine gravel; top of unit is a thin paleosol mottled dark gray (7.5YR 4/1) to dark brown (7.5YR ¾).

Unit 2:
Silty to gravelly sand (SM-SW); mottled strong brown (7.5YR 5/8) and gray (7.5YR 6/1); overall unit coarsens westward to a gravelly sand; moderately dense; moist; gravels and sands are well graded; top of unit is a thin paleosol with yellowish red (5YR 4/6) mottling.

Unit 3:
Fine silty sand with gravel (SM); mottled strong brown (7.5YR 5/8) and gray (7.5YR /1); moderately dense; dry; has numerous fine gravel lenses and stringers; top unit is a thin paleosol with yellowish red (5YR 4/6) mottling.

Unit 4:
Silty sand and sandy gravel (SM-GW); moderately dense to loose; dry; gravels are well graded and subangular to well rounded; gravels are primarily sandstone and siltstone; top unit is a laterally discontinuous paleosol.

Unit 5:
Clayey silt (ML); very dark brown (10YR 2/2) to black; stiff; moist; has fine gravel lenses and stringers near base of unit; gravels are angular to subrounded; unit is a thick paleosol.

Unit 7:
Sand (SP); dark yellowish brown (10YR 4/4); medium dense; moist; has minor fine gravel; unit is capped by modern A horizon which is plowed to a depth of about 1.5 feet.

TABLE 2

RADIOCARBON AGES

Paleoseismic Investigation of the San Andreas Fault Zone
Portola Valley, California

Trench	Sample I.D.	Unit	Radiocarbon Age (B.P.)	Calibrated Age (B.P.)
T-1	T1-S2	2 (base)	4380 +/- 50	4837-5258
T-1	T1-S5	1 (top)	4560 +/- 40	4837-5441
T-3	T3-S35	5* (upper)	1180 +/- 40	944-1227
T-4	T4-S4	1 (middle)	3930 +/- 40	4242-4509
T-4	T4-S5	2 (top)	3880 +/- 50	4151-4418
T-4	T4-S8	3 (middle)	4590 +/- 60	5047-4567
T-4	T4-S18	4 (middle)	2520 +/- 40	2363-2747
T-4	T4-S19	7 (base)	390 +/- 40	317-513
T-4	T4-S21	7 (upper)	370 +/- 40	315-506
T-4	T4-S22	7 (base)	330 +/- 40	304-478
T-4	T4-S23	6 (top)	330 +/- 40	304-478
T-4	T4-S28	7 (lower)	400 +/- 40	319-518
T-5	T5-S8	7 (base)	380 +/_ 40	316-510
T-5	T5-S10	5 (near base)	2510 +/- 40	2362-2744
T-5	T5-S23	4 (near base)	2700 +/- 40	2750-2866

*The units in Trench T-1 have not been correlated with units in the other trenches. The units in Trenches T-4 to T-6 are correlated and same-numbered units are equivalent. Unit 1 in Trench T-3 is correlated with Unit 5 in Trenches T-4 to T-6, and Units 2 to 4 in Trench T-3 are correlated with Units 6 and 7 in Trenches T-3 to T-4.

TABLE 2

RADIOCARBON AGES

Paleoseismic Investigation of the San Andreas Fault Zone
Portola Valley, California

Trench	Sample I.D.	Unit	Radiocarbon Age (B.P.)	Calibrated Age (B.P.)
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T-4	T4-S4	1 (middle)	3930 +/- 40	4242-4509
T-4	T4-S5	2 (top)	3880 +/- 50	4151-4418
T-4	T4-S8	3 (middle)	4590 +/- 60	5047-4567
T-4	T4-S18	4 (middle)	2520 +/- 40	2363-2747
T-4	T4-S19	7 (base)	390 +/- 40	317-513
T-4	T4-S21	7 (upper)	370 +/- 40	315-506
T-4	T4-S22	7 (base)	330 +/- 40	304-478
T-4	T4-S23	6 (top)	330 +/- 40	304-478
T-4	T4-S28	7 (lower)	400 +/- 40	319-518
T-5	T5-S8	7 (base)	380 +/_ 40	316-510
T-5	T5-S10	5 (near base)	2510 +/- 40	2362-2744
T-5	T5-S23	4 (near base)	2700 +/- 40	2750-2866

*The units in Trench T-1 have not been correlated with units in the other trenches. The units in Trenches T-4 to T-6 are correlated and same-numbered units are equivalent. Unit 1 in Trench T-3 is correlated with Unit 5 in Trenches T-4 to T-6, and Units 2 to 4 in Trench T-3 are correlated with Units 6 and 7 in Trenches T-3 to T-4.

Figures

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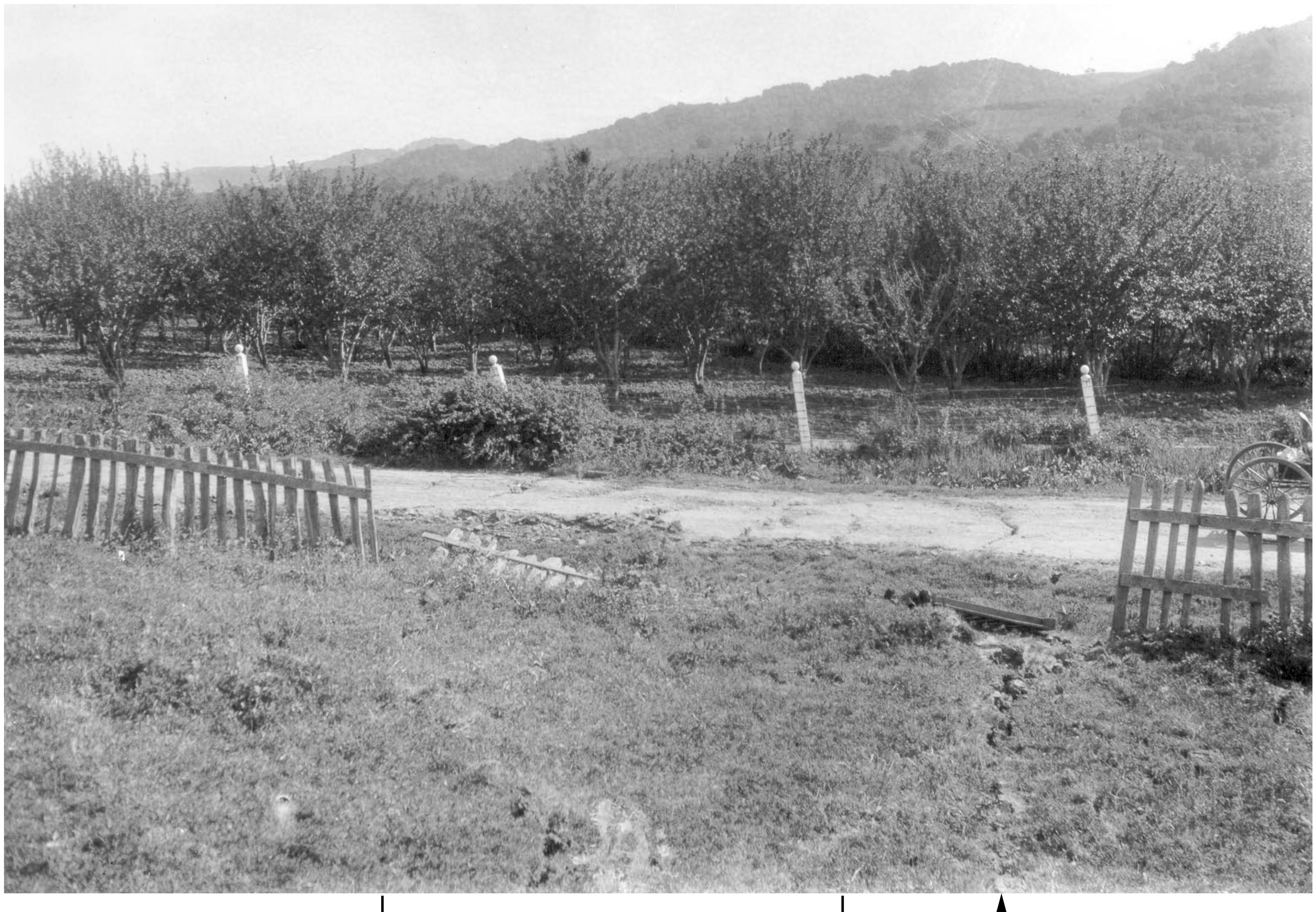


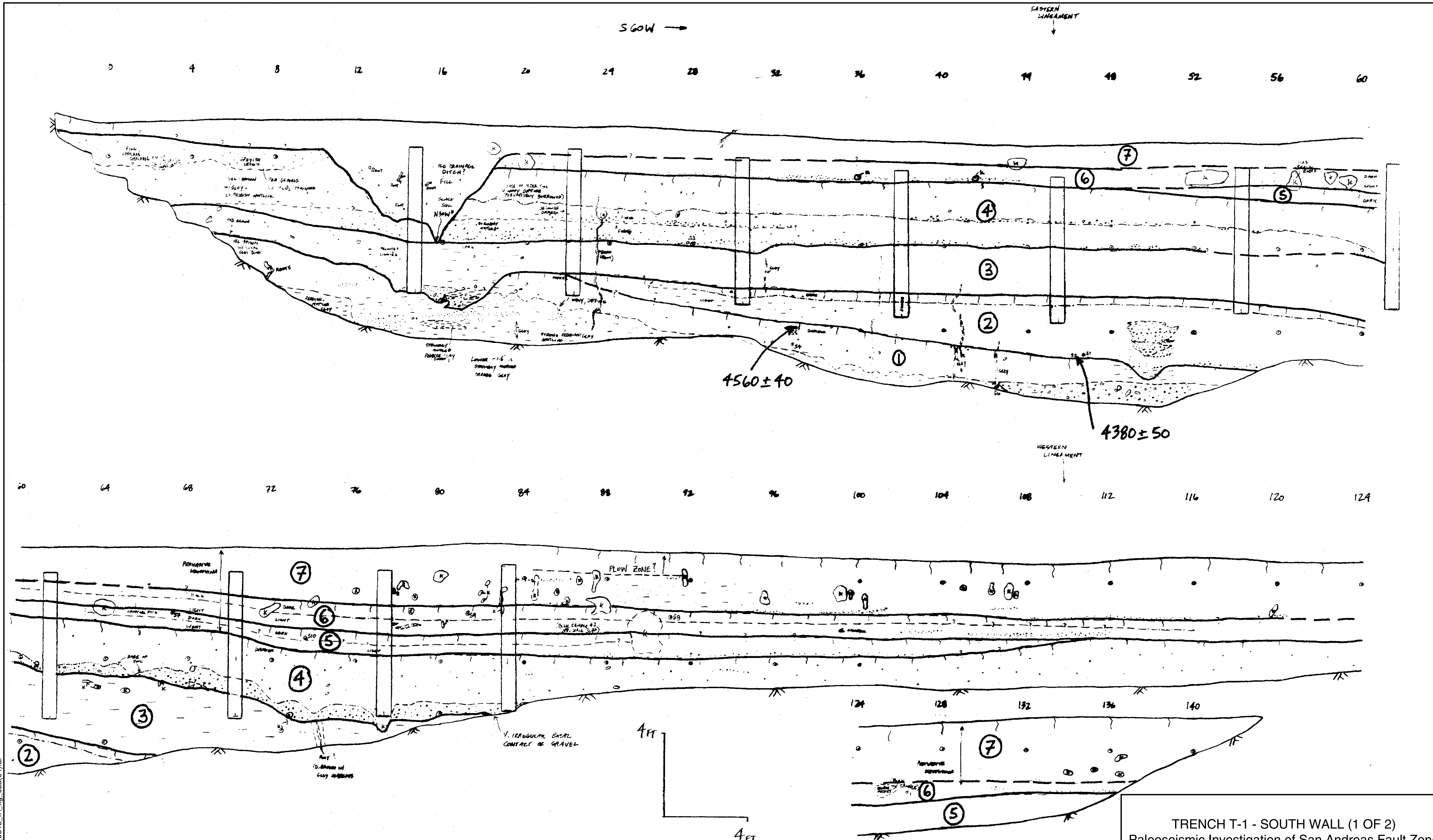
Photo: Stanford University Archives, J. C. Branner Collection, courtesy of the U.S. Geological Survey. See Figure 1 for location (view is to the south).

GEOMATRIX

EN ECHELON CRACKS OF THE WOODSIDE TRACE CROSSING PORTOLA ROAD
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

Project No.
6426

Figure
1



TRENCH T-1 - SOUTH WALL (1 OF 2)
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

GEOMATRIX	Project No.	Figure
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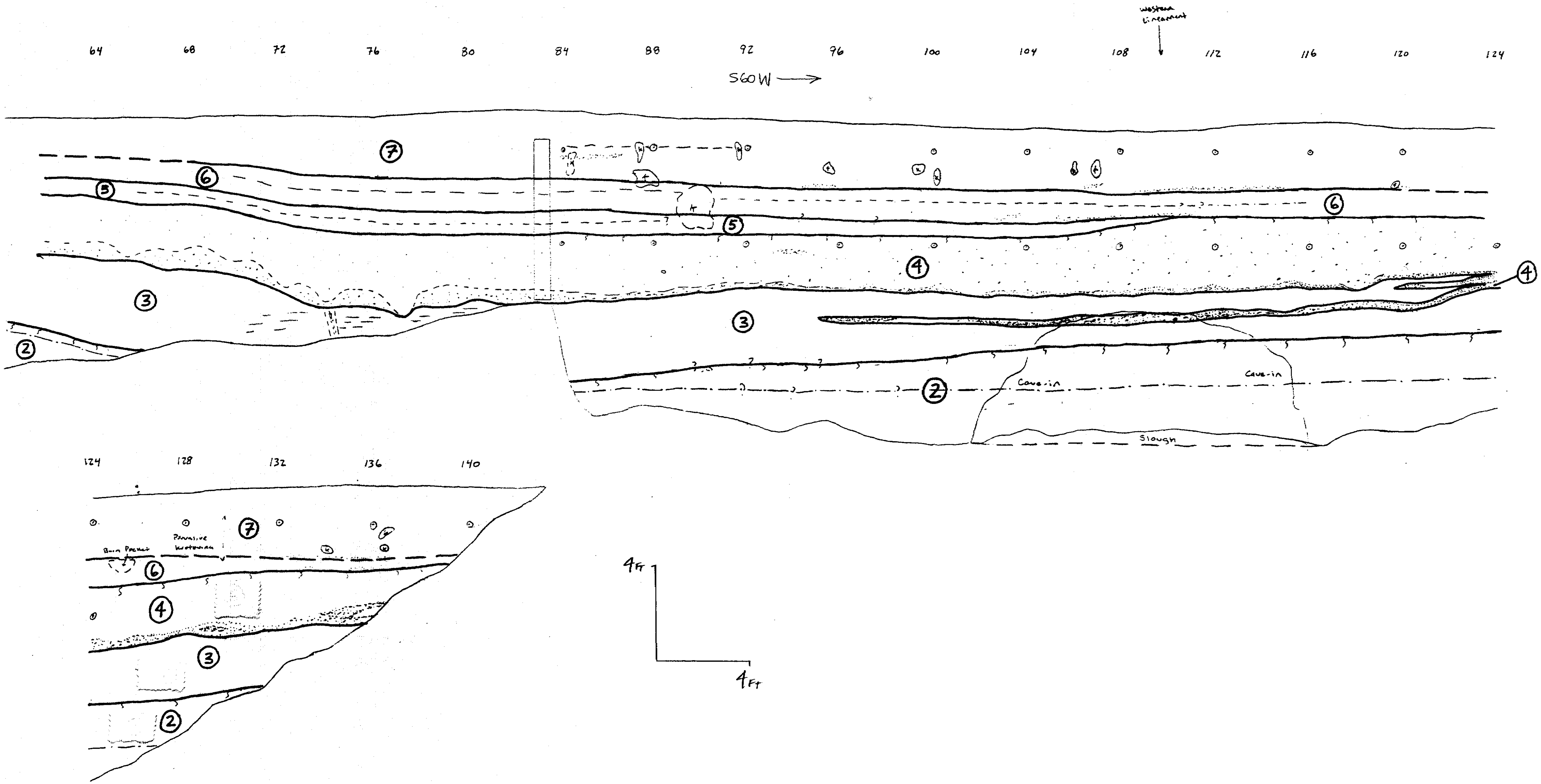

TRENCH T-1 - SOUTH WALL (2 OF 2)
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

GEOMATRIX	Project No.	Figure
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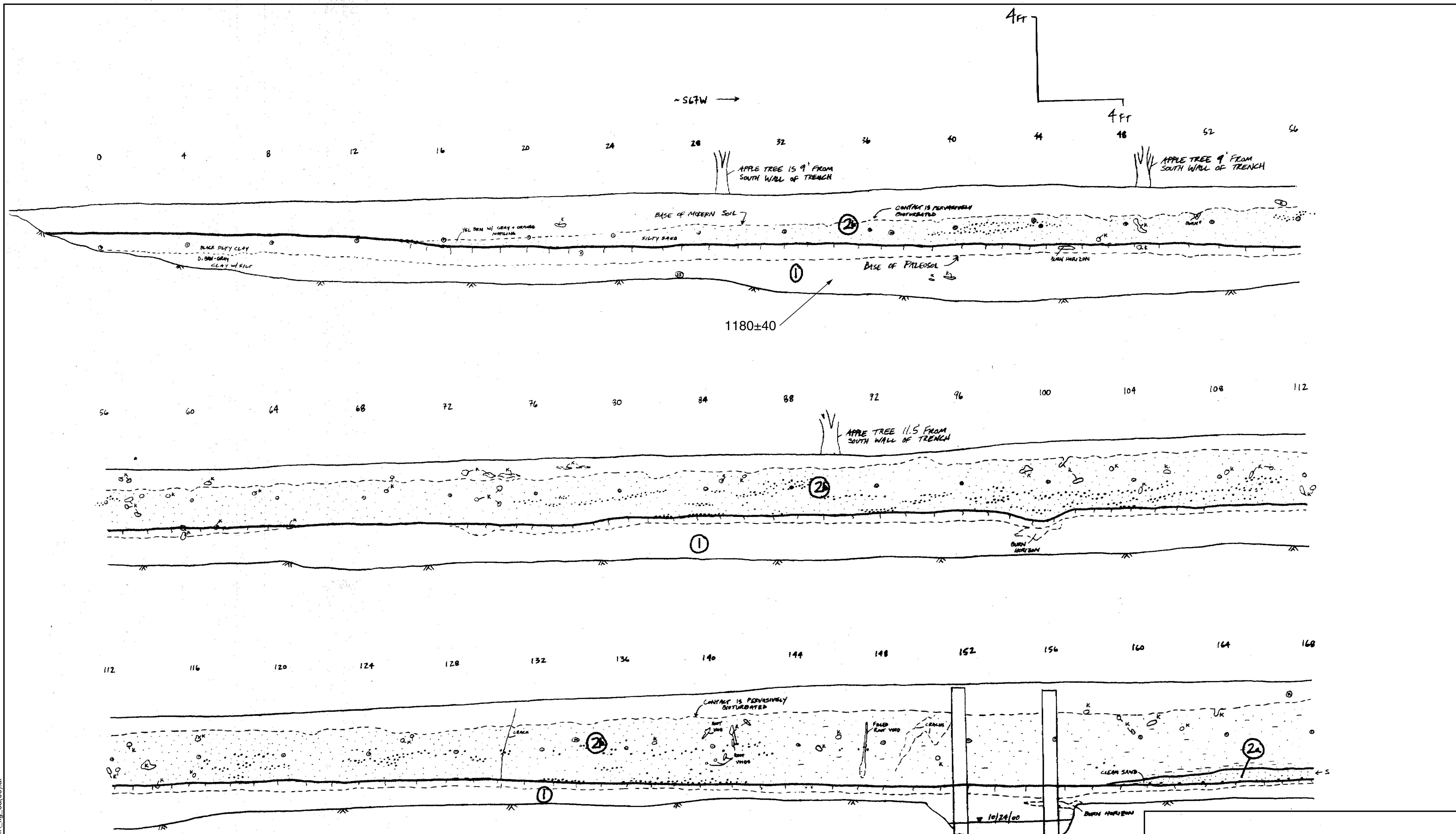

TRENCH T-3 - SOUTH WALL (1 OF 2)
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

GEOMATRIX	Project No.	Figure
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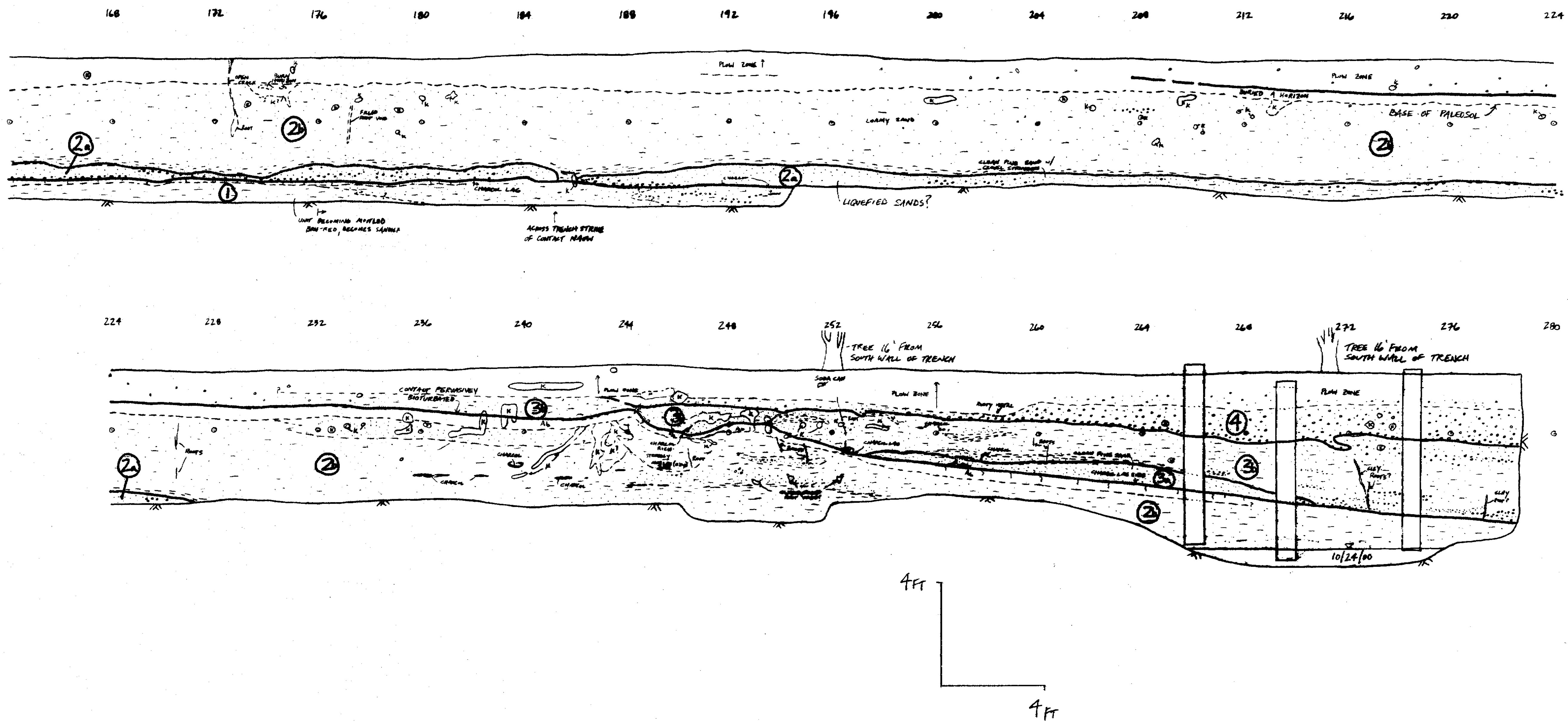

TRENCH T-3 - SOUTH WALL (2 OF 2)
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

GEOMATRIX	Project No.	Figure
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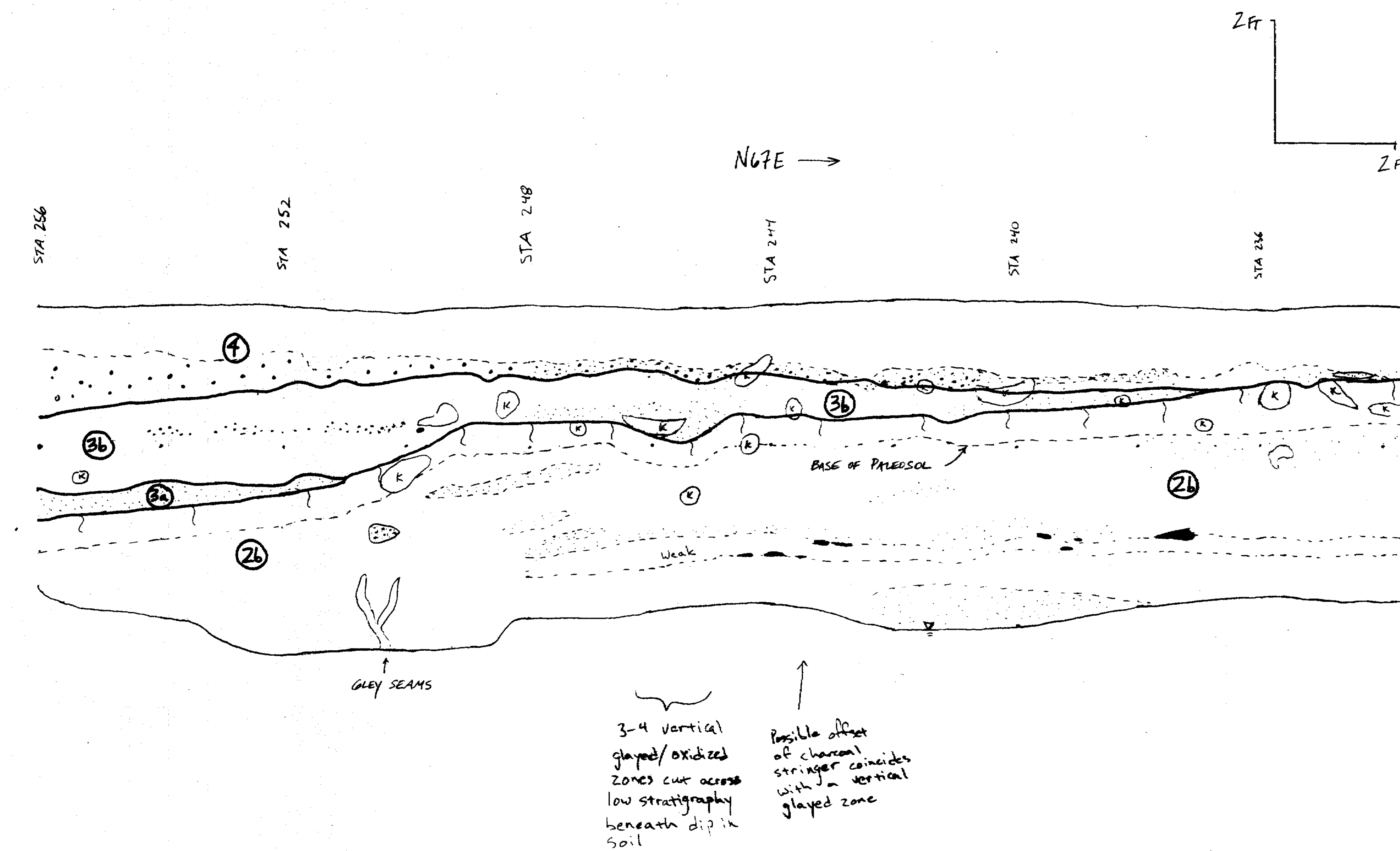

TRENCH T-3 - NORTH WALL
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

GEOMATRIX	Project No.	Figure
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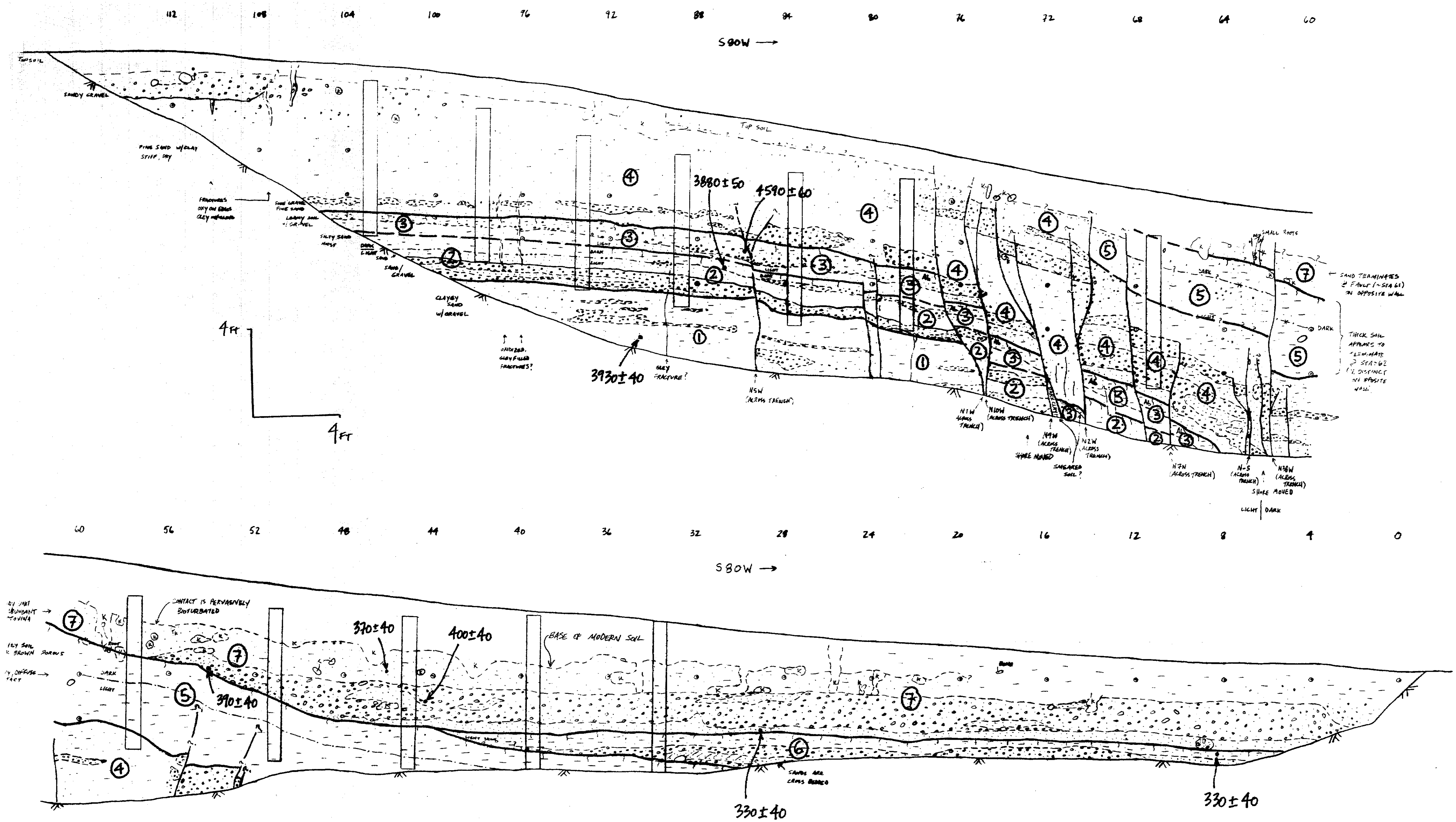

TRENCH T-4 - SOUTH WALL
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

GEOMATRIX

Project No.	Figure
6426	4a

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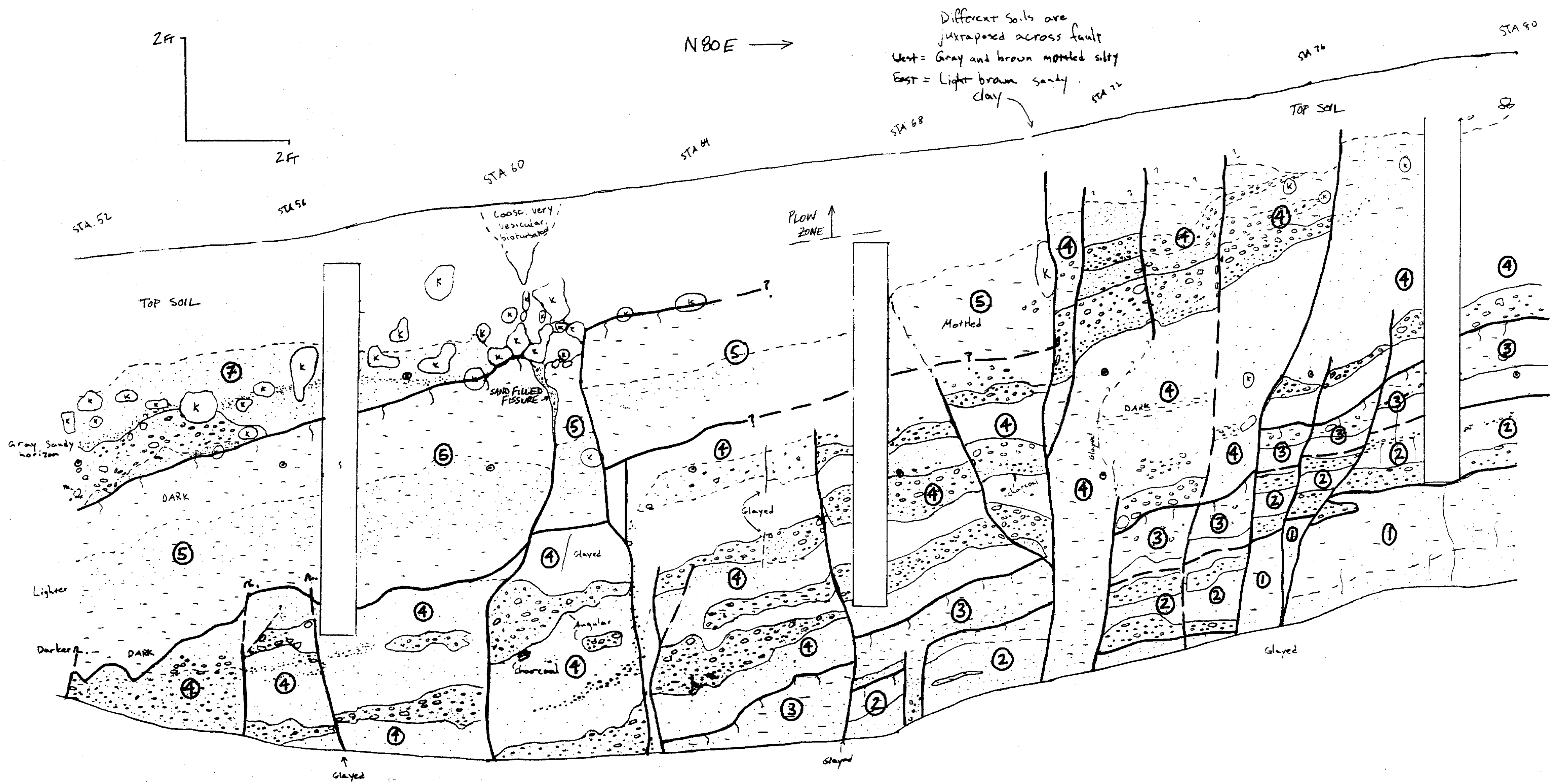

TRENCH T-4 - NORTH WALL
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

GEOMATRIX	Project No.	Figure
	6426	4b

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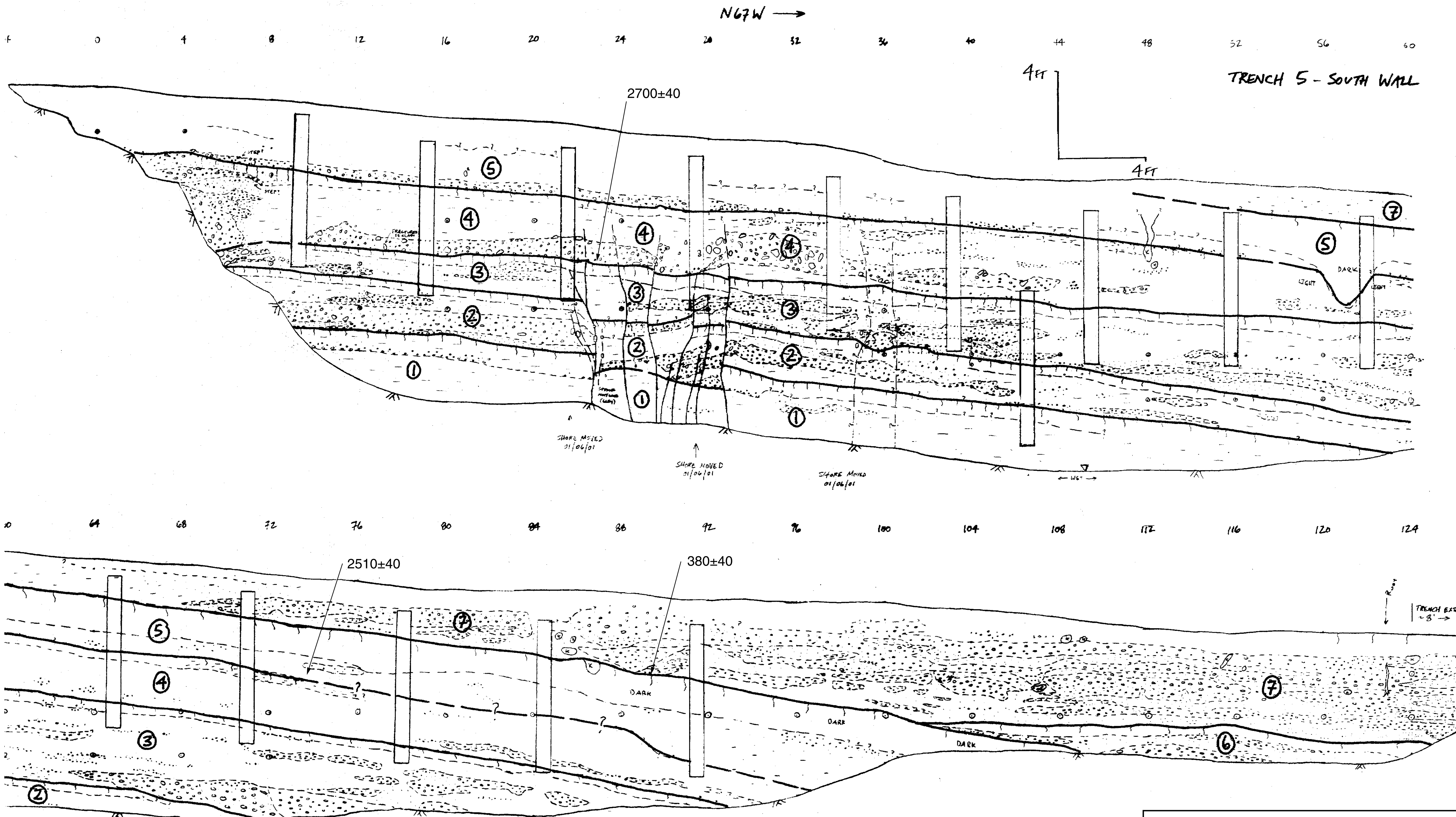

TRENCH T-5 - SOUTH WALL
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

GEOMATRIX

Project No.	Figure
6426	**5a**

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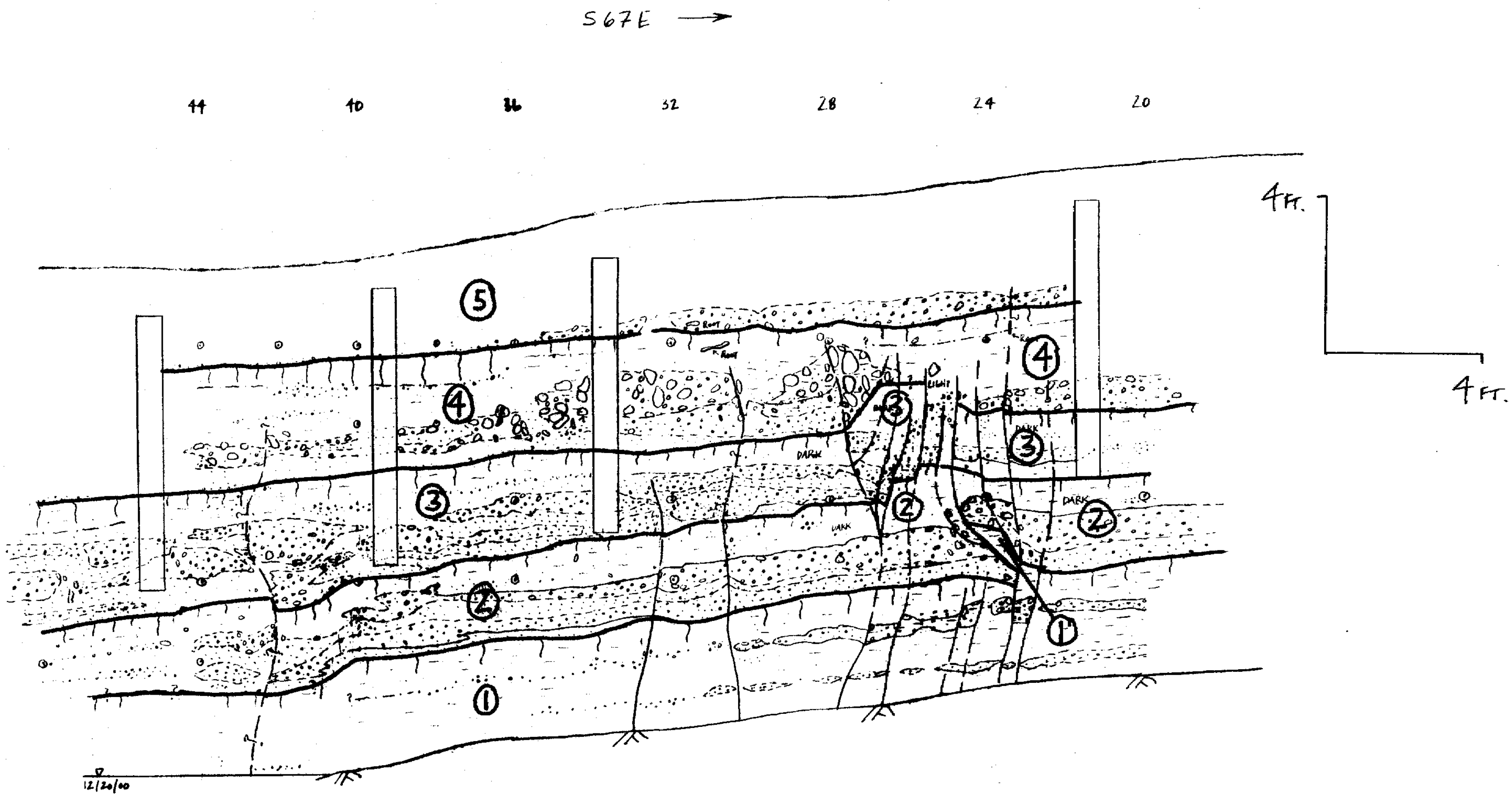
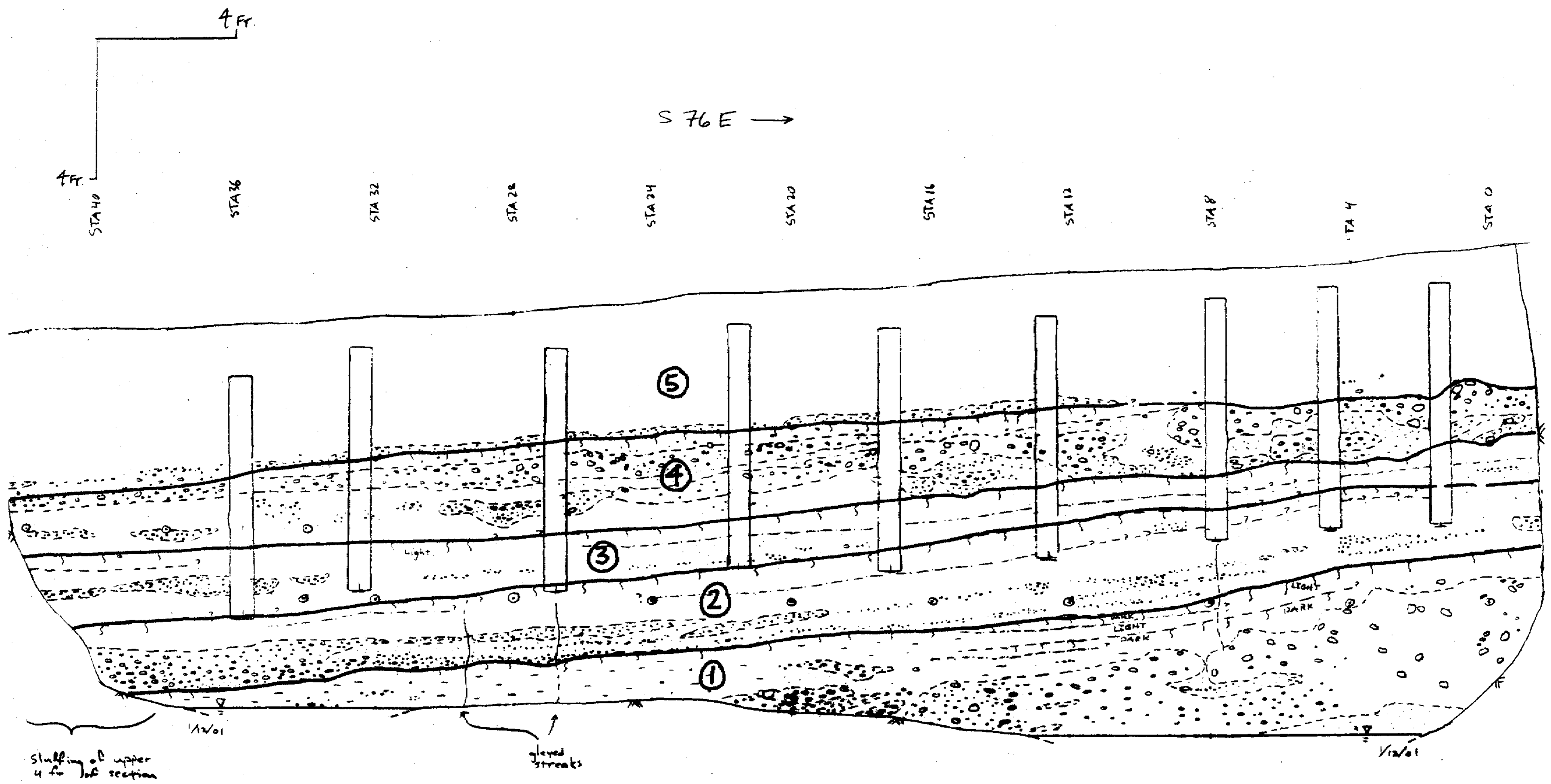


TRENCH T-5 - NORTH WALL
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

GEOMATRIX

Project No.
6426

Figure
5b



TRENCH T-6 - NORTH WALL
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

GEOMATRIX	Project No.	Figure
	6426	6a

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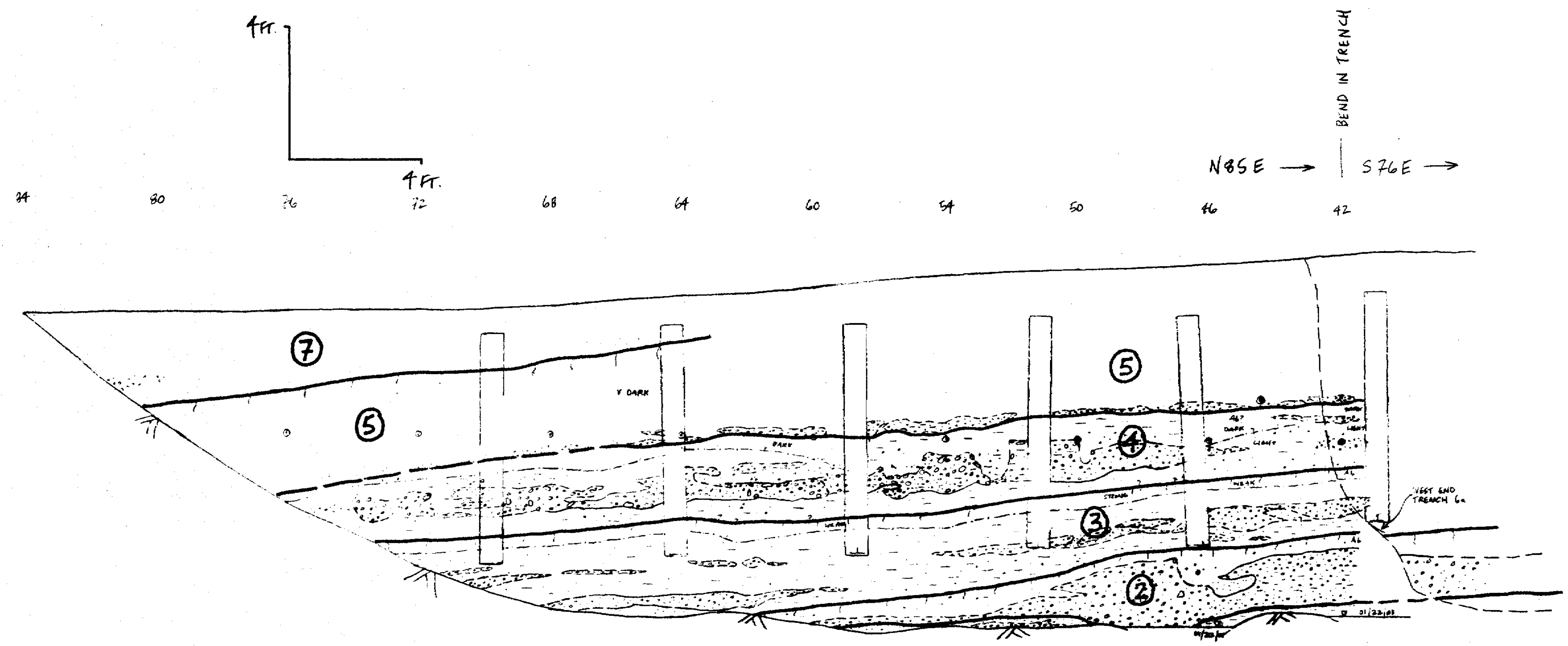

TRENCH T-6 - NORTH WALL
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

GEOMATRIX	Project No.	Figure
	6426	6b

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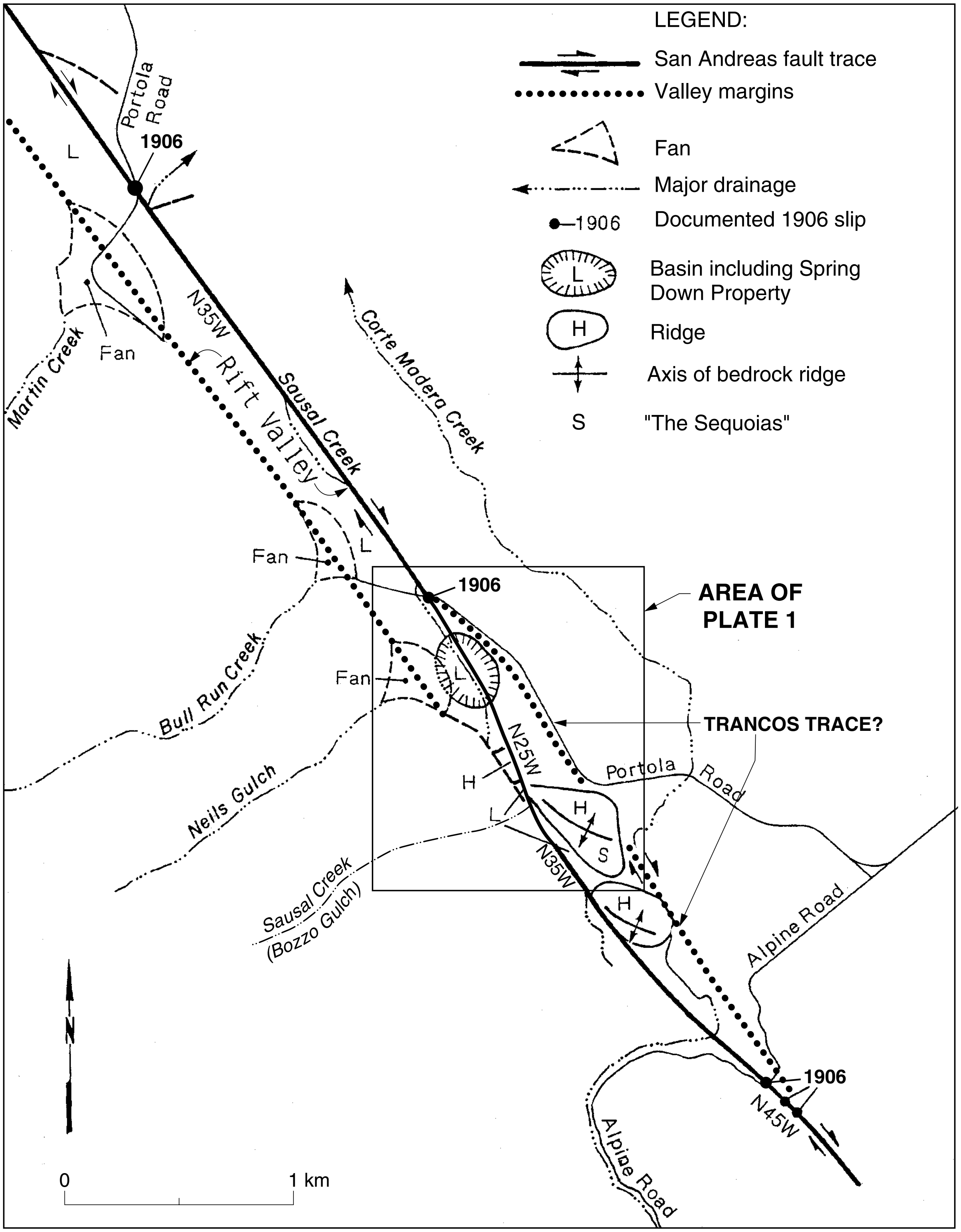

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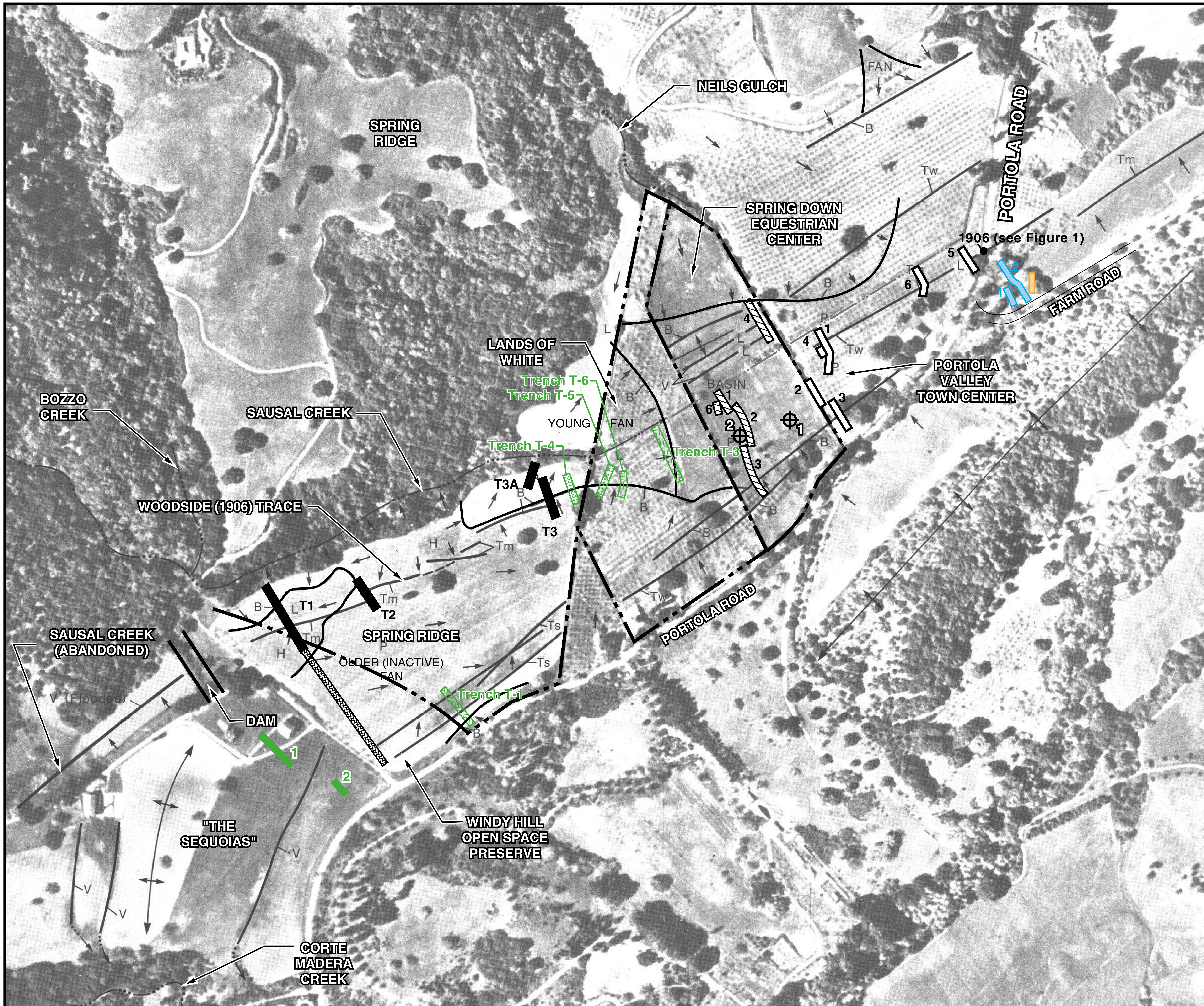
GEOMATRIX

TECTONIC MODEL FOR ORIGIN OF PORTOLA VALLEY
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

Project No.
6426

Figure
7

Plates



LEGEND:

Property boundary; approximately located

Lineament/geomorphic feature: arrow indicates downslope direction
B = Break-in-slope/scarp
V = Trough/linear valley or drainage
Ts = Tonal
s = strong
m = moderate
w = weak
L = Low/wet area
H = High area
P = Planar area

Ridge crest

Drainage: arrow indicates direction of flow

1906 Location of 1906 ground surface rupture

T-4 Trench location - this investigation

PGE trench location (1999)

T2 BAPEX trench location (1998)

1 HTA boring location (1992)

1 HTA trench location (1991)

3 WCC trench location (1976; 1977)

2 WCC trench location (1975)

Wood (1987)

1 Connelly (1997)

Note:

1. Base from 1941 black and white aerial photograph, C.D.M.G. 6000 205 & 206 (stereo), scale 1:24,000
2. Trench and boring locations are approximately located from referenced sources.

0 100 m
0 300 ft.
Approximate scale
1:2500

GEOMATRIX

GEOMORPHIC/LINEAMENT AND EXPLORATION MAP
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, San Mateo County, California

Project No.
6426.000

Plate
1

EXPLANATION

WOODSIDE TRACE: ZONE OF FAULTING AND SIGNIFICANT GROUND DEFORMATION PROJECTED FROM TRENCH DATA. QUERIED WHERE UNCERTAIN.

WOODSIDE TRACE: PROJECTED S32E AS PREVIOUSLY MAPPED ON ADJACENT SPRING DOWN EQUESTRIAN CENTER (HTA, 1991) TO TRENCH T-3.

WOODSIDE TRACE: APPROXIMATELY LOCATED AS MAPPED ON TOWN OF PORTOLA VALLEY GEOLOGIC MAP.

TRENCH T-4 — TRENCH: THIS INVESTIGATION: SHADED AREA SHOWS ZONE OF FAULTING AND SIGNIFICANT GROUND DEFORMATION.

TRENCH 3 — TRENCH: HTA (1998): SHADED AREA SHOWS ZONE OF FAULTING AND SIGNIFICANT GROUND DEFORMATION. WRIGHT, CLAHAN, AND HALL (1999)

TRENCH 6 — TRENCH: HTA (1991): SHADED AREA SHOWS ZONE OF FAULTING AND SIGNIFICANT GROUND DEFORMATION.

CUT SLOPE

FILL SLOPE

PROPERTY BOUNDARY (APPROXIMATELY LOCATED)

DIRT ROAD (APPROXIMATELY LOCATED)

GEOLOGIC CONTACT (APPROXIMATELY LOCATED)

GEOLOGIC UNITS

QUATERNARY	Qaf	ARTIFICIAL FILL
	Qal	FLUVIAL DEPOSITS (Holocene)
	Qalf	ALLUVIAL FAN DEPOSITS (Holocene)

50 0 50
SCALE IN FEET

Note: Topographic base map provided by Rick Skierka

SITE GEOLOGIC AND EXPLORATION MAP
Paleoseismic Investigation of San Andreas Fault Zone
Portola Valley, California

GEOMATRIX

Project No.	Plate
6426	2

Appendix A

Radiocarbon Data Sheets

CENTER FOR ACCELERATOR MASS SPECTROMETRY
Lawrence Livermore National Laboratory

^{14}C results Wright/BAPEX January 10, 2001

==

CAMS #	Sample Name	Other ID	$\delta^{13}C$	fraction Modern	±	$D^{14}C$	±	^{14}C age	±
72131	PV-T4-S4	T4-S4	-25	0.6133	0.0030	-386.7	3.0	3930	40
72132	PV-T4-S5	T4-S5	-25	0.6169	0.0032	-383.1	3.2	3880	50
72133	PV-T4-S8 .14mgC	T4-S8	-25	0.5647	0.0040	-435.3	4.0	4590	60

1) Delta ^{13}C values are the assumed values according to Stuiver and Polach (Radiocarbon, v. 19, p.355, 1977) when given without decimal places. Values measured for the material itself are given with a single decimal place.

2) The quoted age is in radiocarbon years using the Libby half life of 5568 years and following the conventions of Stuiver and Polach (ibid.).

3) Radiocarbon concentration is given as fraction Modern, $D^{14}C$, and conventional radiocarbon age.

4) Sample preparation backgrounds have been subtracted, based on measurements of samples of ^{14}C-free coal. Backgrounds were scaled relative to sample size.

5) Comment: The material dated was acid-base-acid treated charcoal.

CENTER FOR ACCELERATOR MASS SPECTROMETRY
Lawrence Livermore National Laboratory

^{14}C results   Wright/BAPEX   January 31, 2001

CAMS #	Sample Name	Other ID	$\delta^{13}C$	fraction Modern	±	$D^{14}C$	±	^{14}C age	±
72564	PV-T4-19	T4-S19	-25	0.9527	0.0046	-47.3	4.6	390	40
72565	PV-T4-21	T4-S21	-25	0.9552	0.0040	-44.8	4.0	370	40
72566	PV-T4-22	T4-S22	-25	0.9601	0.0048	-39.9	4.8	330	40
72567	PV-T4-23	T4-S23	-25	0.9594	0.0043	-40.6	4.3	330	40
72568	PV-T4-28	T4-S28	-25	0.9515	0.0046	-48.5	4.6	400	40

1) Delta ^{13}C values are the assumed values according to Stuiver and Polach (Radiocarbon, v. 19, p.355, 1977) when given without decimal places. Values measured for the material itself are given with a single decimal place.

2) The quoted age is in radiocarbon years using the Libby half life of 5568 years and following the conventions of Stuiver and Polach (ibid.).

3) Radiocarbon concentration is given as fraction Modern, $D^{14}C$, and conventional radiocarbon age.

4) Sample preparation backgrounds have been subtracted, based on measurements of samples of ^{14}C-free coal.

5) Comment: The materialdated was acid-base-acid treated charcoal.

CENTER FOR ACCELERATOR MASS SPECTROMETRY
Lawrence Livermore National Laboratory

^{14}C results — Crampton/BAPEX — February 27, 2001

CAMS #	Sample Name	Other ID	$\delta^{13}C$	fraction Modern	±	$D^{14}C$	±	^{14}C age	±
73443	Portola/Trancos T1-S2	T1-S2	-25	0.5795	0.0034	-420.5	3.4	4380	50
73444	Portola/Trancos T1-S5	T1-S2	-25	0.5670	0.0028	-433.0	2.8	4560	40

1) Delta ^{13}C values are the assumed values according to Stuiver and Polach (Radiocarbon, v. 19, p.355, 1977) when given without decimal places. Values measured for the material itself are given with a single decimal place.

2) The quoted age is in radiocarbon years using the Libby half life of 5568 years and following the conventions of Stuiver and Polach (ibid.).

3) Radiocarbon concentration is given as fraction Modern, $D^{14}C$, and conventional radiocarbon age.

4) Sample preparation backgrounds have been subtracted, based on measurements of samples of ^{14}C-free coal. Backgrounds were scaled relative to sample size.

5) Comment: The material dated was acid-base-acid treated charcoal.

CENTER FOR ACCELERATOR MASS SPECTROMETRY

Lawrence Livermore National Laboratory

^{14}C results   Crampton/BAPEX   May 21, 2001

CAMS #	Sample Name	Other ID	$\delta^{13}C$	fraction Modern	±	$D^{14}C$	±	^{14}C age	±
75750	PV T4 -S18	T4-S18	-25	0.7311	0.0033	-268.9	3.3	2520	40
75751	PV T5- S23	T5-S23	-25	0.7142	0.0032	-285.8	3.2	2700	40
75752	PV T5-S08	T5-S8	-25	0.9542	0.0039	-45.8	3.9	380	40
75753	PV T5-S10	T5-S10	-25	0.7312	0.0029	-268.8	2.9	2510	40
75754	PV T3-S35	T3-S35	-25	0.8635	0.0037	-136.5	3.7	1180	40

1) Delta ^{13}C values are the assumed values according to Stuiver and Polach (Radiocarbon, v. 19, p.355, 1977) when given without decimal places. Values measured for the material itself are given with a single decimal place.

2) The quoted age is in radiocarbon years using the Libby half life of 5568 years and following the conventions of Stuiver and Polach (ibid.).

3) Radiocarbon concentration is given as fraction Modern, $D^{14}C$, and conventional radiocarbon age.

4) Sample preparation backgrounds have been subtracted, based on measurements of samples of ^{14}C-free coal. Backgrounds were scaled relative to sample size.

5) Comments: The material dated was acid-base-acid treated charcoal.
Sample PV T4-S16 corroded through a combustion tube and will be rerun.